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The Effects of Cognitive General Imagery Use on Tactical Decision-Making in Curling

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Graduate Program in Kinesiology
A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy
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Abstract

The general purpose of this dissertation was to determine the effects of cognitive general (CG; images of game plans and strategies) imagery use on tactical decision-making in curling. This dissertation is divided into four studies. Study 1 outlines the two-stage development of the Curling Strategy Assessment Tool (CSAT-2), a computerized measure of curlers' tactical decision-making (i.e., response accuracy and response speed). During Phase 1, 123 curlers evaluated 75 curling scenarios via an online survey. Twenty-one scenarios showed acceptable interrater agreement for a correct shot option. Pilot testing of the original version of the CSAT indicated that modifications were needed to incorporate strategy style. Thus, Phase 2 was conducted to have 93 updated scenarios assessed by three expert raters (i.e., national-level curling coaches). This process resulted in 104 scenarios that could be used to assess tactical decision-making in curlers undergoing CG imagery interventions using the CSAT-2.

Study 2 consisted of a six-week CG imagery intervention aimed at improving the tactical decision-making abilities of varsity curlers. CSAT data indicated that curlers' response time improved from baseline to post-intervention ($p < .05$). Study 3 examined the effects of an eight-week CG imagery training program on the tactical decision-making abilities of non-elite curlers using a single-subject multiple-baseline design. One curler improved her response accuracy and two curlers decreased their response time following the intervention. In order to gain a greater understanding of CG imagery use, Study 4 sought to determine how CG imagery is employed in curling using focus groups. Results revealed that skips use CG imagery to fulfill both cognitive and motivational functions, depending on the situation.

Overall, this dissertation supports the use of CG imagery to improve tactical decision-making and the use of the CSAT to assess tactical decision-making abilities in curlers. From a practical standpoint, CG imagery training could help improve curlers' tactical decision-making abilities.

Keywords: cognitive general imagery, curling, decision-making, imagery training, sport psychology, strategy

Co-Authorship Statement

The work presented in this dissertation is my original work. However, I would like to acknowledge my co-authors for their roles in this research. I would like to acknowledge my advisor, Dr. Craig Hall, Professor in the School of Kinesiology at Western University, for his contributions and guidance throughout the entire dissertation. I would also like to acknowledge Despina Kouali, PhD Candidate in the School of Kinesiology at Western University, for her help with the data collection and analysis for Study 4.

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List of Abbreviations

| Abbreviation | Meaning | Definition |
|--------------|--|--|
| CG | Cognitive general imagery | Imagery of game plans and strategies |
| CS | Cognitive specific imagery | Imagery of sport skills and techniques |
| CSAT | Curling Strategy Assessment Tool | First version of a measurement tool assessing tactical decision-making in curling (i.e., response accuracy and response time) |
| CSAT-2 | Curling Strategy Assessment Tool-2 | Second version of a measurement tool assessing tactical decision-making in curling (i.e., response accuracy and response time) |
| IAQ | Imagery Assessment Questionnaire | Assessment of imagery practice throughout an intervention |
| MG-A | Motivational general-arousal imagery | Images related to anxiety or emotion regulation |
| MG-M | Motivational general-mastery imagery | Images related to confidence, focus, or mental toughness |
| MIQ-R | Movement Imagery Questionnaire-Revised | Measure of visual and kinesthetic imagery ability |
| MS | Motivational specific imagery | Images related to process and outcome goals |
| SIQ | Sport Imagery Questionnaire | Measure of how often athletes use each of the five imagery functions |

Introduction

For years, it was thought that athletes with expert tactical decision-making skills were experts simply because of their innate cognitive capabilities (Williams & Ward, 2003). However, this is not the case. Research on tactical decision-making suggests that the difference between an expert and novice is the product of hours and hours of sport specific practice, which results in greater sport-specific knowledge and the refining of the cognitive processing of said sport-specific knowledge (Williams & Ward, 2003). There are two aspects of cognition that have been linked to the superior cognitive abilities in expert tactical decision makers: working memory (WM) and learning.

WM is the active maintenance of information for use in an ongoing task (Furley & Memmert, 2010). For example, basketball players with high WM capacities (i.e., athletes who scored in the top 20% following a counting span task) were able to block out distracting auditory stimuli and focus their attention on making better tactical decisions (Furley & Memmert, 2012). Information is stored in WM as “chunks,” with individuals being able to maintain 7 ± 2 chunks of information at any given time (Miller, 1956). This is also known as their WM capacity, which has effects on attentional focus and cognitive processing when it comes to sport performance (Furley & Memmert, 2010). WM is also related to one’s long term memory (LTM) in that information can be relayed between the WM and LTM through areas in the brain known as the phonological loop (responsible for verbal processing) and visuo-spatial sketchpad (responsible for visual-spatial processing).

Learning occurs when the repeated stimulus of information produces changes in cognitive structure of the brain (Doyon & Benali, 2005). WM plays a role in learning when information that is continually rehearsed (i.e., verbally or visually) is stored in

LTM for future use. This requires conscious effort and is known as explicit learning. Another form of learning, implicit learning, occurs when information is obtained and stored without conscious effort (Raab, 2007). Both forms of learning are important for superior tactical decision-making in the lab, but differences arise when subjected to real-world situations, such as performing under pressure (Furley & Memmert, 2010).

Tactical Decision-Making in Sport

The first researchers to examine the expert/novice difference found that experts have superior sport-specific cognitive skills. Simon and Chase (1973) found that chess players had superior recall and pattern recognition skills when compared to novice chess players. The expert chess players were better at recalling the positions of playing pieces, as well as using advanced pattern recognition skills to quickly determine the best move to play in a given situation. In addition, the experts seemed to have a larger WM capacity, evidenced by the fact that they were able to successfully play more than one game at a time. Simon and Chase reasoned that the expert chess players had spent a significant amount of time developing their chess “vocabulary” through hours of practice, making it more likely that they have seen a given chess scenario at least once before. In addition, it was thought that as a result of all that practice, the experts had refined their cognitive capacity to process and store information.

Building on these results, Starkes (1987) tested elite and novice field hockey players on a variety of cognitive tasks. Although elite and novice athletes performed similarly on general cognitive tasks (e.g., simple visual response time), the elite athletes performed better on sport-specific cognitive tasks (e.g., recall of game-specific information, using advanced visual cues to predict opponents’ movements, and making

accurate tactical decisions). Together, these findings highlight important differences in the cognitive processing occurring in elite athletes' brains.

Using eye movement tracking devices, Williams, Ward, Knowles, and Smeeton (2002) found that elite tennis players were looking more at their opponent's head/shoulders and hips/trunk to determine, from prior experience, what stroke their opponent was going to play and where the ball was going to end up. Contrary to this, novice tennis players spent more time looking at the opponent's racket and the ball in order to determine where the ball was going to go. It was concluded that the novice athletes are relying more on declarative (i.e., explicit knowledge) to make a decision, while elite athletes were basing their decisions on years of prior experience (i.e., implicit knowledge), which requires less decision time (Williams et al., 2002). Raab and Laborde (2011) also noted that experts are generally more intuitive decision makers (i.e., they base decisions on prior experience), while novices are more deliberate decision makers (i.e., they require more conscious thought, WM capacity). These differences in decision-making processes are largely tied to experience, as well as how the abilities to make decisions have been acquired (i.e., implicit versus explicit learning).

A meta-analysis showed that experts generally have greater response accuracy and shorter response times, due to their superior perceptual abilities, as well as the ability to obtain a greater amount of relevant information from a smaller number of eye fixations, allowing them to make decisions faster (Mann, Williams, Ward, & Janelle., 2007). Expert decision makers generally have significantly more sport specific experience (i.e., practice and play) compared to non-expert decision makers (Williams, Ward, Bell-Walker, & Ford, 2012), thus explaining their superior tactical decision-

making in terms of anticipation, recall, and pattern recognition (e.g., Simon & Chase, 1973; Starkes, 1987; Williams et al., 2002; Williams et al., 2012). The majority of research discussed has used computerized or lab tasks to show differences in tactical decision-making between expert and novice sport performers. A few have included field tasks as well, showing evidence of transfer of learning from the lab to the field (e.g., Williams et al., 2002). While tasks can be explicitly and implicitly learned, greater tactical performance is seen with implicit skills, as they tend to hold up under situations of pressure and anxiety (Raab, 2007). Knowing that expert decision-making reflects refined WM abilities, research should examine how less experienced athletes can develop their strategy abilities through sport-specific training. One such avenue may be through imagery training, considering the link with the visuo-spatial sketchpad in memory (Furley & Memmert, 2010).

Imagery in Sport

Imagery is one of the most popular techniques in psychological skills training programs (Short et al., 2002). Imagery involves the mental simulation of performing physical skills, and is associated with changes in motor learning, cognition, affect, and behaviour (Martin, Moritz, & Hall, 1999). Imagery can be defined as “an experience that mimics real experience. We can be aware of “seeing” an image, feeling movements as an image, or experiencing the real thing ... It differs from dreams in that we are awake and conscious when we form an image” (White & Hardy, 1998, p. 389). From a neurocognitive perspective, imagery is thought to be a central part of the visuo-spatial system, playing a major role in consciousness and memory (Murphy, Nordin, & Cumming, 2008). In this way, imagery is thought to be an active process that prepares

athletes to receive and process information. If an athlete rehearses a particular image enough times, a deeper memory trace is created and that image becomes more vivid and easily retrievable when needed (Murphy et al., 2008).

According to Paivio (1985), athletes use imagery for both cognitive and motivational functions operating at both a general and a specific level. Hall, Mack, Paivio, and Hausenblas (1998) expanded Paivio's conceptual model into five imagery functions: cognitive general (CG; sport-specific strategies), cognitive specific (CS; sport-specific skills), motivational general-arousal (MG-A; arousal and stress), motivational general-mastery (MG-M; control, mental toughness, and self-confidence), and motivational specific (MS; goal-oriented responses). This expansion into five different imagery functions led to the development of the Sport Imagery Questionnaire (SIQ; Hall et al., 1998), which has become the most prevalent tool in measuring the frequency of imagery use in athlete populations.

Research on the five imagery functions has typically focused on CS or MG-M imagery. For example, youth athletes improved their soccer performance following a CS imagery intervention (Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012). Callow, Hardy, and Hall (2001) found significant increases in the sport confidence of badminton players following a MG-M imagery intervention. Despite these results, Murphy (1994) argued that the focus on certain imagery functions has caused researchers to overlook how imagery can help athletes in other ways (e.g., the use of CG imagery to improve strategy performance; Martin et al., 1999).

Cognitive General (CG) Imagery

Historically, research on CG imagery has consisted of anecdotal evidence and case study reports, revealing a gap in the literature (Martin et al., 1999). These limited reports suggest that CG imagery is used to practice and improve game strategies in sports such as skiing (Rotella, Gansneder, Ojala, & Billing, 1980), golf (Paivio, 1985), football (Fenker & Lambiotte, 1987), wrestling (Rushall, 1988), pommel-horse routines in gymnastics (Mace, Eastman, & Carroll, 1987), artistic gymnastics (White & Hardy, 1998), canoe slalom races (MacIntyre & Moran, 1996; White & Hardy, 1998), and climbing (Boyd & Munroe, 2003). For example, canoeists reported visualizing how they navigated through a race course and strategically planned the most effective route to take (White & Hardy, 1998).

Westlund, Pope, and Tobin (2012) conducted a review to determine what CG imagery research had been conducted since Martin and colleagues (1999) pointed out the gap in the literature. Although a modest number of studies had been published, most of them were descriptive in nature, focusing on factors that influence CG imagery use (e.g., age or competitive level; McCarthy, Jones, Harwood, & Olivier, 2010), correlations with other variables (e.g., confidence; Callow & Hardy, 2001), or reasons why athletes use CG imagery (e.g., strategy development and execution; Munroe, Giacobbi, Hall, & Weinberg, 2000). Thus, research questions still remained in regards to the outcomes of CG imagery use, which are often best answered through intervention studies.

To date, only a handful of imagery interventions have examined the effectiveness of CG imagery use, either alone or in combination with other types of imagery. Furthermore, some of these interventions did not explicitly discuss the use of CG

imagery, but instead described general imagery training to help improve strategy performance. For example, Jordet (2005) found that soccer players who engaged in weekly imagery training improved their visual exploratory activity in game situations. The frequency of exploratory activity increased and the time between the last exploratory search and receiving the ball decreased, highlighting an improvement in the athletes' tactical decision-making skills. Guillot, Nadrowska, and Collet (2009) found that basketball game strategies that were practiced both mentally and physically, or just physically were performed better than strategies that were not practiced at all. This finding suggests that the use of imagery in combination with physical practice might be an efficient way to learn a new basketball strategy (Guillot et al., 2009).

In regards to interventions that explicitly considered the use of CG imagery, mixed results have been found. Following a season-long individualized imagery intervention with an elite rugby player, CG imagery was reported to be useful in game preparation (i.e., using tactical and technical images), as well as boosting his confidence (Evans, Jones, & Mullen, 2004). This intervention was the first to highlight the benefits of CG imagery use beyond the traditional strategy-based functions. In contrast, Munroe-Chandler, Hall, Fishburne, and Shannon (2005) failed to find a strategy performance effect following a six-week CG imagery intervention with youth soccer players. Although the athletes increased their use of CG imagery throughout the intervention, analyses of the athletes' strategy performances were limited because the targeted strategies did not occur often enough to provide sufficient data. Strategy performance showed a positive trend, however, it was not significant (Munroe-Chandler et al., 2005).

Two other CG imagery interventions combined the use of CG imagery with other types of imagery. Soccer players who practiced imagery scripts containing CG and CS imagery prompts significantly increased their passing performance compared to soccer players who did not (Seif-Barghi, Kordi, Memari, Mansournia, & Jalali-Ghomi, 2012). Combining both CG and CS imagery can be effective because strategies are comprised of specific skills in real game situations (Munroe-Chandler et al., 2005; Seif-Barghi et al., 2012). Furthermore, tennis players who practiced scripts containing CG, CS, and MG-M imagery prompts experienced significant improvements in their performance, as well as enhanced their experiences of flow (Koehn, Morris, & Watt, 2015). In addition to improving their national junior rankings, three of the four athletes improved their groundstroke performance, and all four athletes improved their service performance.

The aforementioned imagery interventions have found support for the use of CG imagery in rugby (Evans et al., 2004), soccer (Munroe-Chandler et al., 2005; Seif-Barghi et al., 2012), basketball (Guillot et al., 2009), and tennis (Koehn et al., 2015). CG imagery interventions that incorporated other types of imagery (i.e., CS and/or MG-M imagery) were successful in improving athletes' overall performance and experience of flow (Koehn et al., 2015; Seif-Barghi et al., 2012). However, mixed results were obtained regarding the overall effectiveness of CG imagery-based interventions to improve athletes' strategy performance, which is the function identified as being employed most often when athletes use CG images (Short, Monsma, & Short, 2004).

A potential reason for the lack of CG imagery interventions and mixed findings in the interventions described above may be related to the difficulty in measuring strategy performance (Westlund et al., 2012). Strategies are manifested differently across sports,

and can often be difficult to control in real-world situations. For example, Munroe-Chandler and colleagues (2005) found that two of the strategies to be evaluated throughout their intervention did not appear as frequently as they had hoped. If a different method to test strategies had been used, Munroe-Chandler and colleagues may have seen a greater effect of CG imagery on strategy performance. In contrast, Seif-Barghi and colleagues (2012) assessed tactical decision-making in the form of an observable skill, providing enough data to demonstrate an intervention effect. Therefore, it is important for researchers to determine how strategy is manifested in a particular sport context and develop an effective measure of strategy performance (i.e., tactical decision-making) in order to investigate the outcomes of CG imagery use more precisely.

Purpose of Dissertation

The overall purpose of this dissertation was to determine the effects of CG imagery use on tactical decision-making in one specific sport, curling. The sport of curling was chosen because of the unique way in which strategy is employed throughout a curling game. Curling is often referred to as “chess on ice” (Haggerty, 2013) because players are constantly required to plan two or three shots ahead when making tactical shot decisions. The unique nature of curling makes it difficult to compare it to other sports (e.g., soccer, canoeing) in which CG imagery has been examined. This dissertation is divided into four studies. The purpose of Study 1 was to develop a measurement tool to assess tactical decision-making in curling. The Curling Strategy Assessment Tool (CSAT-2) was developed over two phases. During Phase 1, 75 curling scenarios were assessed by having curlers who play the positions of skip or vice determine the most correct shot option for each scenario. Following pilot testing of the original version of

the CSAT, modifications were made to the scenarios. Thus, Phase 2 was conducted to assess the updated scenarios comprising the CSAT-2 using input from expert curling coaches.

Study 2 and Study 3 consisted of CG imagery interventions that tested the utility of the CSAT and CSAT-2 in an applied setting. The purpose of Study 2 was to determine whether a six-week CG imagery intervention could improve the tactical decision-making abilities of varsity curlers, as measured by the CSAT. A secondary purpose was to determine whether the varsity curlers' imagery ability and CG imagery use increased from baseline to post-intervention. Due to ceiling effects observed in the varsity curlers' tactical decision-making abilities, the purpose of Study 3 was to examine the effects of an eight-week CG imagery training program on the tactical decision-making abilities of non-elite curlers, as measured by the CSAT-2, using a single-subject multiple baseline design.

In order to gain a broader understanding of CG imagery use, a qualitative approach was used in Study 4 to determine how CG imagery is used in the context of curling. Focus groups were conducted with curlers to gather in-depth information regarding where, when, why, and how they use CG imagery in various curling contexts.

This dissertation follows an integrated-article format, one of the approved formats accepted by the School of Graduate and Postdoctoral Studies at Western University. Each study was prepared to be published separately as articles in academic journals, thus some repetition occurs between the general introduction and discussion of this dissertation and the content of the four studies.

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Study 1

Development of the Curling Strategy Assessment Tool (CSAT)

In sport, athletes use imagery to serve a variety of functions. Paivio (1985) was the first to conceptualize athletes' imagery use into either cognitive or motivational functions, each operating at a general or specific level. Hall, Mack, Paivio, and Hausenblas (1998) further conceptualized sport imagery functions into five categories: cognitive general (CG; game plans and strategies), cognitive specific (CS; sport skills and techniques), motivational general-arousal (MG-A; anxiety and emotions), motivational general-mastery (MG-M; confidence, focus, and mental toughness), and motivational specific (MS; goal-oriented responses).

Imagery interventions examining the effects of the various types of imagery on performance have generally focused on CS imagery and MG-M imagery. For example, athletes who practiced CS imagery for six weeks improved their performance on a soccer task (Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012). Callow, Hardy, and Hall (2001) increased the sport confidence of badminton players following three weeks of biweekly MG-M imagery training. These studies provide important insights into how imagery can be used to improve athletes' performance. However, the focus on certain functions (e.g., CS and MG-M) can cause researchers to miss other ways that imagery use can benefit athletes (Murphy, 1994), such as the use of CG imagery to improve strategy performance (Martin, Moritz, & Hall, 1999).

Anecdotal reports and case studies have shown that athletes use CG imagery to improve their performance in a variety of sports, including football (Fenker & Lambiotte, 1987) and canoe slalom races (White & Hardy, 1998). Only two CG interventions have

been conducted to date, revealing mixed results regarding the effects of CG imagery on strategy performance. Munroe-Chandler, Hall, Fishburne, and Shannon (2005) found that athletes increased their use of CG imagery across the intervention period. However, results were unclear whether the CG training improved performance of soccer strategies because the strategies to be examined did not occur often enough for a detailed analysis. Alternatively, Guillot, Nadrowska, and Collet (2009) found that the use of imagery in conjunction with physical practice might be an efficient way to learn new basketball strategies. Compared to Munroe-Chandler and colleagues who examined strategy performance during actual games, Guillot and colleagues assessed strategy performance during training sessions.

The lack of CG imagery interventions may be the result of the difficulty in measuring strategy performance (Westlund, Pope, & Tobin, 2012). One such difficulty is that the execution of strategies in real-world situations can be challenging to control under experimental conditions (e.g., Munroe-Chandler et al., 2005). To overcome these difficulties, researchers could look to cognitive psychology for ways to measure strategy behaviour and cognitions (Westlund et al., 2012) since the brain's memory systems are involved in sports that require the execution of game plans or routines (Murphy, Nordin, & Cumming, 2008). Working memory (WM) is a memory system used to maintain information for use in an ongoing task (Furley & Memmert, 2010). Athletes are known to use their WM to help solve problems encountered during competition (Taylor, Pham, Rivkin, & Armor, 1998). The amount of information athletes can store in their WM at one time can affect their attentional focus and cognitive processing (Furley & Memmert, 2010). Athletes with higher WM capacities make better tactical decisions because they

are able to block out distractions and focus their attention on appropriate cues (Furley & Memmert, 2012). These expert decision-makers exhibit superior sport-specific cognitive and perceptual abilities compared to novices (e.g., Starkes, 1987). Thus, a reliable and valid measure of sport-specific decision-making abilities would be useful in determining whether tactical decision-making improves because of CG imagery training. The sport of curling was chosen because of its highly strategic nature, requiring curlers to plan two or three shots ahead and anticipate their opponents' shot selections when planning and executing their own game plans. Thus, the purpose of the present study was to develop the Curling Strategy Assessment Tool (CSAT), a curling-specific measure of tactical decision-making. The development of the CSAT occurred over two phases.

Phase 1: Initial Item Assessment using an Online Questionnaire

The purpose of this phase was to assess the interrater reliability of 75 curling scenarios developed for the CSAT. Interrater reliability refers to the extent that scores on a measure are consistent across different raters (Goodwin, 2001). Each scenario was assessed to determine the most correct shot to play in each situation.

Method

Participants

Participants were 123 curlers who self-identified as playing at either club ($n = 44$) or competitive ($n = 79$) levels participated in this study ($M_{age} = 37.20$, $SD = 13.25$). Of the 123 participants, there were 88 males (71.5%) and 32 females (26.0%). Among the curlers who identified as competitive athletes, 23 (29.1%) identified as having played at the provincial level, 28 (35.4%) played at the national level, and 20 (25.3%) competed at the international level. Although there were 151 individuals who started the online

questionnaire, participants were removed from the final analysis if they did not answer at least 50% of the scenarios, started the questionnaire more than once, indicated playing only recreationally, or did not indicate playing the positions of skip or vice.

Measures

Demographic information. A Curling Demographic Questionnaire was designed for the present study. It asked participants to report their age, gender, years of curling experience, and positions played.

Curling Strategy Assessment Tool (CSAT). Seventy-five different curling scenarios were developed to be used in the CSAT based on coaching resources, games available on television and online, and through the author's personal experiences as a competitive curler and coach with over 20 years of experience. Each scenario consisted of background information regarding the game situation (i.e., score, end being played, last rock advantage, which rock is being thrown, colour rocks being thrown), a diagram showing the house and playing area, and four shot options. Participants were also provided with a text box to suggest a shot option if the shot they would play was not listed. In the instructions, participants were informed that the scenarios were from a 10-end game, to assume normal ice conditions (i.e., any shot was possible), and assume that their players could make any shot. There was no time limit imposed on the participants when making a decision regarding the correct shot for each scenario and they could change their response before advancing to the next scenario.

Procedure

Following approval from Western University's Research Ethics Board, Club Managers at various curling clubs across Ontario were contacted via email and asked to

forward the study information and link for the online questionnaire to their members. The study information was also posted online on a popular curling forum to reach a wider population. Completion of the questionnaire indicated consent, and it took participants approximately 45 to 60 minutes to complete all 75 scenarios. To avoid participants experiencing fatigue while completing the scenarios, optional break pages were included after every 15 scenarios.

Results

Additional shot options that were entered by participants were manually added to the analysis as new shot options and included in the percentage agreement calculations. Inter-rater agreement was calculated for each scenario using percent agreement (Goodwin, 2001). For each scenario, the shot option with the highest percentage was deemed as the one chosen as the most correct response. A percent agreement of 70% or greater was used to determine whether acceptable interrater agreement was obtained for the most correct shot option (Jackson, 2011). Twenty-one out of the 75 scenarios showed an acceptable level of interrater agreement equal to or greater than 70% for a correct shot option (Table 1). Fifty-four scenarios showed an unacceptable interrater agreement level of less than 50% (Table 2).

Discussion

The purpose of Phase 1 was to determine the interrater reliability of 75 curling scenarios in terms of the most correct shot to play in each situation. Interrater reliability is important when subjective opinions are required to score events (Goodwin, 2001). The 21 scenarios with acceptable interrater reliability were used in Study 2 to evaluate tactical decision-making of varsity curlers participating in a CG imagery intervention.

Table 1

Scenarios that showed acceptable inter-rater agreement ($\geq 70\%$)

| Scenario | Correct Shot Option | Percentage | <i>n</i> |
|----------|---|------------|----------|
| 1 | Takeout | 85.2 | 122 |
| 3 | Draw to side of the house | 79.3 | 121 |
| 7 | Clockwise draw around red guard | 72.7 | 110 |
| 9 | Draw to top 4-foot | 76.4 | 110 |
| 12 | Bumper hit and roll behind centre guard | 88.5 | 104 |
| 17 | Tap straight back to top 4-foot | 76.6 | 94 |
| 23 | Freeze to opponent's rock on T-line | 86.2 | 87 |
| 28 | Double takeout on rocks in 4-foot | 83.7 | 86 |
| 34 | Peel one of the guards | 90.4 | 83 |
| 36 | Clockwise hit just off nose (high side) | 97.5 | 81 |
| 37 | Tick shot | 74.1 | 81 |
| 43 | Tight guard | 75.3 | 81 |
| 44 | Centre guard | 96.3 | 81 |
| 45 | Double peel on two centre guards | 93.8 | 81 |
| 46 | Double peel guard near centre line | 73.8 | 80 |
| 53 | Counter clockwise draw to side of house thru port | 70.1 | 77 |
| 57 | Double peel on middle guards | 70.5 | 78 |
| 58 | Draw around guards to top button | 83.3 | 78 |
| 65 | Draw to T-line in 4-foot (in front of red rock) | 92.1 | 76 |
| 72 | Clockwise draw to the button | 78.4 | 74 |
| 74 | Nose hit on top red rock sitting full 8-foot | 95.9 | 74 |

Table 2

Scenarios that showed unacceptable inter-rater agreement ($< 70\%$)

| Scenario | Correct Shot Option | Percentage | <i>n</i> |
|----------|--|------------|----------|
| 2 | Nose hit | 48.4 | 122 |
| 4 | Nose hit | 58.2 | 122 |
| 5 | Freeze | 61.5 | 122 |
| 6 | Hit and roll | 50.0 | 110 |
| 8 | Freeze to the red rock | 47.3 | 110 |
| 10 | Hit centre guard | 59.1 | 110 |
| 11 | Bumper-weight hit and roll behind corner guard | 53.8 | 104 |
| 13 | Freeze to opponent's rock | 43.3 | 104 |
| 14 | Nose hit using yellow rock in top 12-foot | 24.3 | 103 |
| 15 | Runback | 68.3 | 104 |
| 16 | Runback on rock in top 12-foot | 69.9 | 93 |
| 18 | Draw to the button | 46.8 | 94 |
| 19 | Freeze to opponent's rock in back 4-foot | 50.0 | 94 |
| 20 | Clockwise draw with backing | 33.3 | 93 |
| 21 | Draw to top 4-foot | 42.5 | 87 |
| 22 | Nose hit on rock sitting back 8-foot | 35.6 | 73 |
| 24 | Hit and roll to side of the house | 37.9 | 87 |

(continued)

Table 2 *cont.*

| Scenario | Correct Shot Option | Percentage | <i>n</i> |
|----------|--|------------|----------|
| 25 | Half-way centre guard | 69.0 | 87 |
| 26 | Freeze to your rock | 33.7 | 86 |
| 27 | Double peel using guard | 65.1 | 86 |
| 29 | Second corner guard | 59.3 | 86 |
| 30 | Hit and roll behind guard | 31.4 | 86 |
| 31 | Centre line guard | 50.6 | 83 |
| 32 | Counter clockwise hit and roll to sit on opponent's other rock | 47.0 | 83 |
| 33 | Throw away | 45.8 | 83 |
| 35 | Hit and roll behind guard | 39.8 | 83 |
| 38 | Counter clockwise peel | 48.1 | 81 |
| 39 | Halfway centre guard | 59.3 | 81 |
| 40 | Counter clockwise draw to edge of 4-foot, behind opponent's rock | 56.8 | 81 |
| 41 | Draw behind guard | 38.3 | 81 |
| 42 | Hit and roll behind guard | 64.2 | 81 |
| 47 | Clockwise draw behind centre guard | 63.6 | 79 |
| 48 | Counter clockwise draw for 1 (no backing) | 48.1 | 79 |
| 49 | Hit and roll on rock in back 12-foot (right side) | 62.5 | 80 |
| 50 | Hit and roll on red rock in 4-foot | 46.3 | 80 |
| 51 | Tap red rock to back 12-foot | 52.6 | 78 |
| 52 | Nose hit on red rock closest to centre line | 59.7 | 77 |
| 54 | Draw to 4-foot | 64.6 | 79 |
| 55 | Draw to top 8-foot on centre line | 34.2 | 79 |
| 56 | Hit top red rock and roll in front of the other one | 47.4 | 78 |
| 59 | Nose hit on red rock on left side | 48.7 | 78 |
| 60 | Freeze to red rock on T-line | 69.2 | 78 |
| 61 | Freeze to red rock on T-line (left side) | 59.7 | 77 |
| 62 | Tap yellow rock to T-line | 34.2 | 76 |
| 63 | Double peel using guards touching centre line | 69.7 | 76 |
| 64 | Double takeout by hitting between two red rocks | 59.7 | 77 |
| 66 | Freeze to red rock back 4-foot | 28.9 | 76 |
| 67 | Nose hit on red rock biting top 4-foot | 45.9 | 74 |
| 68 | Draw behind yellow guard on the right | 69.3 | 75 |
| 69 | Clockwise freeze to red rock | 48.7 | 76 |
| 70 | Draw to top 12-foot on centre line | 32.9 | 76 |
| 71 | Counter clockwise peel using red guard near centre line | 40.0 | 75 |
| 73 | Angle raise takeout using yellow guard on left side | 65.3 | 75 |
| 75 | Corner freeze on right side of red rock biting top 4-foot | 54.7 | 75 |

There are some limitations to note. First, despite “break pages” being included after every 15 scenarios, many participants failed to complete the entire questionnaire because of its length. Future studies could randomize the items and have each participant assess a selection of the items. Second, the data were collected during the curling off-season. Thus, it was based on retrospective recall of game situations. Future research should collect data from participants during the curling season when curlers are actively playing in games, thus making it easier for them to think of the correct shot option. Finally, a drawback of using the percent agreement method is it does not account for ratings that occur by chance (Lombard, Snyder-Duch, & Campanella Bracken, 2002).

Phase 2: Item Refinement using Expert Coaches

Based on feedback from curlers and coaches who completed the CSAT, the items were modified to include strategy style as an additional variable. In curling, there are three strategy styles that curlers generally follow when selecting a game plan: defensive, offensive, or blended (Canadian Curling Association, 2010). Accordingly, certain shots tend to be played in conjunction with these strategy styles. Given that this change potentially affected the correct answer for each scenario, a second stage of item assessment was required. The purpose of this phase was to continue to develop the CSAT-2 to reflect a more accurate depiction of the types of tactical decisions encountered during a curling game. Expert coaches were recruited to determine the most correct answer for each scenario given the particular strategy style used.

Method

Participants

Three curling coaches with Level 3 certification according to the old National Coaching Certification Program system (Canadian Curling Association, 2013) participated as the expert raters in this study. Together, they had an average of 16.67 years ($SD = 4.73$) of experience coaching curling teams at provincial, national, and international levels.

Measures

Demographic information. A Demographic Questionnaire was designed for this study. It asked coaches to report their age, gender, and coaching experience in curling.

Curling Strategy Assessment Tool (CSAT-2). In total, 93 curling scenarios were assessed by the expert raters. Although only 21 of the original scenarios were deemed reliable in Phase 1, a decision was made to re-assess all 75 scenarios as strategy style was not an original consideration. It was possible that the 21 scenarios had a clear strategy style imposed by the background information, while the other scenarios had a number of correct answers considering that more than one of the three strategy styles could apply. Furthermore, of the 75 scenarios that were originally developed in Phase 1, some were repeated in this phase to incorporate more than one possible strategy style, thus increasing the total number of scenarios to be assessed to 93. Each scenario consisted of background information regarding the game situation (i.e., score, end being played, last rock advantage, which rock is being thrown, colour of rocks being thrown, and strategy style being used), a diagram showing the house and playing area, and four shot options. Some of the scenarios were repeated two or three times, if it was

appropriate in those scenarios to have a defensive, offensive, or blended shot option. In the instructions, the coaches were informed that the scenarios were from a 10-end game, to assume normal ice conditions (i.e., any shot was possible), and assume that their players could make any shot. They were also to make their ratings based on strategies that would be employed by youth curlers (under 21 years). No time limit was imposed on the coaches to determine the most correct answer for each scenario.

Procedure

This study was approved by Western University's Research Ethics Board. The coaches were recruited in-person by the primary researcher from her experience as an athlete and curling coach. The three coaches met with the primary researcher at a curling club and assessed each of the 93 scenarios for the most correct answer.

Results

All 93 scenarios were assessed in one of three ways: a) the three coaches reached 100% agreement on the most correct answer, b) the coaches provided recommendations on how to improve or modify some scenarios in order to reach 100% agreement, or c) additional scenarios were added by considering variations based on the three types of strategies used. Scenarios were removed from the item pool if 100% agreement was not met or if the coaches felt they were unrealistic. In total, 104 scenarios remained in the item pool following the assessment.

Discussion

The purpose of this phase was to further develop the original CSAT as many of the scenarios employed in Phase 1 had been revised to include the three strategy styles (i.e., offensive, defensive, and blended). Together, the three expert coaches were able to

come to 100% agreement on 104 scenarios that comprise the item pool for the CSAT-2. It should be noted that some researchers suggest that at least five expert raters should be used to avoid ratings occurring by chance (Lynn, 1986). However, the number of expert raters used can be affected by availability of individuals with the appropriate levels of relevant expertise (Dunn, Bouffard, & Rogers, 1999). This limitation was overcome because the three coaches discussed each scenario together rather than choosing the correct shot option individually. The design of this assessment phase can be considered a strength because the coaches were able to discuss each of the scenarios in a focus group-like environment (Krueger & Casey, 2009), rather than independently choose an answer for each scenario, which is the traditional method employed using expert raters (Dunn et al., 1999). The discussions were very collegial and this atmosphere provided a richer environment for the coaches to discuss, in-depth, the correct shot to play in each of the scenarios presented while taking into account each of their own experiences and potential biases. The 104 scenarios were used in Study 3 to assess tactical decision-making as an outcome measure in non-elite curlers participating in a CG imagery intervention.

General Discussion

The lack of CG imagery interventions conducted in sport may be the result of a lack of reliable and valid measures of strategy performance (Westlund et al., 2012). The CSAT-2 helps to fill this gap by assessing tactical decision-making in curling. Although the assessment of the scenarios focused on response accuracy, a strength of the CSAT-2 is that it measures both response accuracy and response time in curlers' tactical decision-making. In competition, curlers are limited to 38 minutes of thinking time during a 10-end game (Canadian Curling Association, 2014) to make appropriate strategy decisions

that increase their chances of winning a game. Thus, it is imperative that curlers make both accurate and quick strategy decisions because they forfeit the ability to play any remaining rocks if they run out of thinking time. As curlers improve their response accuracy, they can begin to focus on improving their response time (e.g., Beilock, Bertenthal, Hoerger, & Carr, 2008), thus ensuring they make the most efficient use of their thinking time during a competitive curling game.

The CSAT-2 needs to undergo further testing in an applied setting to determine its utility in a curling sample, as well as further assess the psychometric properties of the CSAT-2 (i.e., test-retest reliability and predictive validity). While the CSAT-2 was initially developed to assess tactical decision-making as an outcome measure in CG imagery interventions, it can also be used as a training tool to teach curlers about the various strategy styles and develop their abilities to recognize what shots should be called in different game situations.

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Study 2

The Effects of Cognitive General Imagery Use on Decision Accuracy and Speed in Curling¹

Curling is often referred to as “chess on ice” (Haggerty, 2013). Its highly strategic nature requires players to think two or three shots ahead at all times. In competition, curlers are allotted 38 minutes of thinking time during a 10-end game (Canadian Curling Association, 2014). This time limit restricts the amount of time players have to make strategy decisions to less than 30 seconds per shot. If a team runs out of thinking time, they forfeit their ability to play any remaining rocks and could lose the game. Thus, not only is it important for curlers to learn to make strategy decisions quickly in order to conserve time, but also to ensure they are still making accurate decisions in each situation throughout a competitive game.

The decision-making process in curling is largely controlled by the brain’s working memory (WM; Baddeley & Hitch, 1974). WM is the active maintenance of information for use in an ongoing task (Furley & Memmert, 2010). WM is comprised of four components (Baddeley & Hitch, 1974). The phonological loop is responsible for verbal processing. The visuo-spatial sketchpad deals with visual and spatial information. The central executive controls and manipulates information being processed by either the phonological loop or the visuo-spatial sketchpad (Baddeley, 2009). The episodic buffer facilitates the interaction of information between the other components of WM, long-term memory, and perception (Baddeley, 2000).

¹ A version of this study will be published in *The Sport Psychologist* (in press).

Information is stored in WM as “chunks,” with individuals being able to maintain 7 ± 2 chunks of information at any given time (Miller, 1956). This ability to maintain information is also known as WM capacity, which can have a number of effects on attentional focus and cognitive processing when it comes to sport performance (Furley & Memmert, 2010). For example, basketball players with high WM capacities (i.e., athletes who scored in the top 20% following a counting span task; Kane et al., 2004) were able to block out distracting auditory stimuli and focus their attention on making better tactical decisions (Furley & Memmert, 2012).

Learning occurs when the repeated stimulus of information produces changes in the cognitive structure of the brain (Doyon & Benali, 2005). WM plays a role in learning when information that is continually rehearsed (either verbally or visually) is eventually stored in LTM for future use. This verbal or visual rehearsal requires conscious effort, which is known as explicit learning. Another form of learning, implicit learning, occurs when information is obtained and stored without conscious effort (Raab, 2007). With implicit learning, athletes simply learn by doing; they cannot verbalize specific rules, however, they know how to act in a given situation (Raab, 2007). While both forms of learning are important for superior tactical decision-making in the laboratory, important differences arise when subject to real-world situations, such as performing under pressure (Furley & Memmert, 2010). Performance during pressure situations is more likely to fail when an athlete relies on explicit knowledge compared to implicit knowledge (Masters, 1992). A reason for this performance deficiency is that the anxiety and worry that accompany pressure situations can interfere with an athlete's WM capacity, limiting their ability to use their explicit knowledge (Furley & Memmert, 2010).

Visual imagery and the manipulation of images is controlled by the visuo-spatial sketchpad (Baddeley, 2009). Robbins and colleagues (1996) found that both the visuo-spatial sketchpad and central executive are involved in choosing the next best move in chess, as participants were required to plan potential moves while visualizing the positions of the chess pieces on the board. Within their neurocognitive model of imagery in sport, exercise, and dance, Murphy, Nordin, and Cumming (2008) suggested that the use of imagery is a central process within the visuo-spatial system, an important aspect of consciousness and memory. Because of its involvement in conscious awareness, imagery is considered by the model to be an active process in the realm of sport, whereby athletes prepare to receive information as opposed to passively interpreting stored information (Murphy et al., 2008). The more often that imagery of specific sport skills or strategies are rehearsed, the images become more vivid and thus can be focused upon or recalled more easily in order to make a faster decision. Frequent rehearsal of sport-specific images increases its depth of processing (Murphy et al., 2008). Storage of information into the LTM system from the WM system occurs with continual rehearsal of that information. Murphy and colleagues also proposed that the deeper processing that occurs with frequent imagery practice creates unique associations held by the individual.

Within the sport domain, imagery use by athletes is focused around the following five functions, as put forth by Hall, Mack, Paivio, and Hausenblas (1998): cognitive general (CG; sport-specific strategies), cognitive specific (CS; sport-specific skills), motivational general-arousal (MG-A; arousal and stress) and motivational general-mastery (MG-M; control, mental toughness, and self-confidence) and motivational specific (MS; goal-oriented responses). The two cognitive functions (i.e., CG and CS

imagery) require more use of WM because they typically represent covert rehearsal of strategies and skills compared to motivational functions that tend to elicit behavioural responses (Paivio, 1985). While CS imagery consists of images of specific sport skills and techniques, the combination of sport-specific skills and techniques makes up CG imagery (Murphy et al., 2008). Between the two, research in sport psychology has maintained a focus on the use of CS imagery to learn sport specific skills in order to improve athletes' overall performance (e.g., Callow, Hardy, & Hall, 2001). For example, research by Blair, Hall, and Leyshon (1993) found that biweekly imagery rehearsal of a soccer task over six weeks significantly improved participants' time in completing the task at post-test compared to a control group. A similar study found that children who practiced CS imagery over a six-week period improved their performance on a soccer task compared to athletes who practiced MG-A imagery (Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012). In addition, Cumming and Ste-Marie (2001) found an increase in the use of CS imagery following a five-week imagery intervention, regardless of the athletes' preferred imagery perspective (i.e., internal or external).

The combination of CS images to form CG imagery helps athletes understand and problem solve the various situations that they encounter in sport. While one might think this combination would be better suited to the verbal portion of WM (i.e., phonological loop), some researchers have found support for imagery (i.e., visuo-spatial sketchpad) serving this purpose (Murphy et al., 2008). Anecdotal evidence and a number of case study reports (for a review, see Martin, Moritz, & Hall, 1999; Paivio, 1985) suggest that CG imagery is used to practice and improve game strategies in sports such as skiing, golf, football, wrestling, gymnastics, and canoe slalom races. For example, canoeists have

been found to visualize how they will navigate through a race course and strategically plan the most effective route to take (White & Hardy, 1998).

In their review of the literature, Martin and colleagues (1999) suggested that there is a need for researchers to investigate the effects of CG imagery on the learning and performance of game plans, routines, and strategies. Since then, however, only two controlled studies have attempted to improve strategy performance through CG imagery training (Guillot, Nadrowska, & Collet, 2009; Munroe-Chandler, Hall, Fishburne, & Shannon, 2005), yielding mixed results. Guillot and colleagues found that the use of CG imagery by national female basketball players to learn tactical strategies in conjunction with physical practice was more effective than having the athletes engage only in physical practice. CG imagery was not found to be more effective than physical practice, leading the authors to conclude that imagery practice could be used as an alternative practice technique in order to prevent overtraining. Munroe-Chandler and colleagues attempted to increase the execution of soccer strategies by a young elite soccer team using CG imagery. While they found that the athletes increased their use of CG imagery from baseline to post-intervention, CG imagery practice did not significantly improve strategy execution. A potential reason for these mixed findings might be due to difficulties in measuring strategy performance in sport (Westlund, Pope, & Tobin, 2012). Strategy is not easily controllable in real-world sport situations (e.g., Munroe-Chandler et al., 2005). Thus, researchers should aim for a balance in ensuring that their intervention has ecological validity, but also provides sufficient opportunities to assess strategy performance (Pinder, Davids, Renshaw, & Araújo, 2011).

Building on these two previous studies, the purpose of the present study was to determine if a six-week imagery intervention could improve the accuracy and speed of athletes' strategy abilities as the result of an increased depth of processing or learning effect (Murphy et al., 2008). The sport of curling was targeted and a strategy assessment tool was developed to assess curling strategy ability. A secondary purpose was to determine whether curlers improved in their CG imagery use and imagery ability following the six-week imagery intervention.

Method

Participants

A men's and women's varsity curling team from a post-secondary school in Southwestern Ontario participated in a six-week CG imagery intervention. In total, 11 varsity athletes ($M_{age} = 21.09$ years, $SD = 1.87$) participated in the intervention, including five females and six males. Players from all four positions on a curling team were represented (i.e., lead, second, vice, and skip). The athletes had been curling for an average of 13.27 years ($SD = 3.07$) and reported having played varsity curling for 2.64 years ($SD = 1.75$). In addition, the athletes reported spending an average of 2.45 days per week ($SD = 0.79$) engaging in on-ice practice and 3.09 days per week ($SD = 1.76$) engaging in off-ice practice (e.g., cardio, strength, or mental training). All curlers had experience competing at provincial or national levels, thus they would be classified as intermediate and advanced athletes (Baker, Wattie, & Schorer, 2015).

Measures

Demographic information. A demographic questionnaire was developed for the present study. It asked participants' age, gender, curling experience (e.g., years as a

varsity athlete, highest competitive level played achieved, position played) and amount of time dedicated to the sport (e.g., days spent engaged in on-ice and off-ice practices).

Strategy ability. The CSAT (developed in Phase 1 of Study 1) was used to assess strategy ability (i.e., response accuracy and response speed) in the present study. The strategy assessment was computer-based, and consisted of 12 curling scenarios with four shot options. The 12 scenarios were chosen from the pool of 21 validated scenarios to ensure that a variety of situations were represented. At the start of each scenario, athletes were presented with background information for that scenario, including the score of the game, end being played, whether their team had last rock advantage, who on their team was about to throw, and how many rocks remained in that end. After a brief delay, a diagram of the house (i.e., coloured circles that constitute the scoring area) and any rocks present appeared along with four shot options. Participants were to select the shot option they felt was most appropriate for that scenario. Participants were scored based on whether they chose the correct strategy for a given scenario, as well as timed to see how long it took them to choose the correct response (i.e., response time). If the incorrect response was selected, the amount of time taken was deemed irrelevant. Only participants' response times for scenarios with correct responses were used to calculate their average response time at each time point.

Imagery ability. The Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) was used as a screening tool to assess athletes' visual and kinesthetic imagery ability at the start of the intervention and again following the end of the intervention. The MIQ-R consists of eight items (four pertaining to visual imagery ability and four pertaining to kinesthetic imagery ability). Participants are instructed to

first physically perform a simple movement and then immediately visualize performing that same movement. They then rate the ease of visualizing that movement on a 7-point scale ranging from 1 (*very hard to see*) to 7 (*very easy to see*) for the visual imagery ability scale and from 1 (*very hard to feel*) to 7 (*very easy to feel*) for the kinesthetic imagery ability scale. A mean was calculated for all items comprising the visual imagery ability subscale and the kinesthetic imagery ability subscale, resulting in a mean score ranging from 1 to 7 for each participant. A higher score means that participants have an easier time using imagery. A mean score of four or greater on each subscale has been used to determine whether athletes have sufficient imagery ability to participate in an intervention (e.g., Munroe-Chandler et al., 2012). Cronbach alpha coefficients for the present sample were .88 and .81 for the visual and kinesthetic subscales at pre-intervention and .84 and .85 at post-intervention, indicating good internal consistency for this sample. Factorial validity has also been supported (Monsma, Short, Hall, Gregg, & Sullivan, 2009). Data from this sample of athletes and dancers indicated that visual and kinesthetic imagery ability are separate, but related constructs (Monsma et al., 2009).

Imagery use. The Sport Imagery Questionnaire (SIQ; Hall et al., 1998) was used to assess athletes' use of the five imagery functions at the start and end of the intervention. The SIQ consists of 30 items rated on a 7-point scale ranging from 1 (*rarely*) to 7 (*often*) in terms of the athlete's level of agreement with each item. A mean was calculated using the responses for all items comprising each subscale, resulting in a mean score ranging from 1 to 7, which higher values indicating more frequent use of an imagery function. A shortened version of the SIQ was used to track athletes' CG and CS imagery use over the course of the intervention. It consisted of the 13 items that made up

the CG and CS imagery subscales and was rated on the same 7-point scale (described above). Acceptable internal consistency values for the 30-item SIQ were found to range from .70 to .88 in the development of the questionnaire (Hall et al., 1998). Predictive and factorial validity of the SIQ has also been supported previously (Hall et al., 1998; Hall, Stevens, & Paivio, 2005). Cronbach's alpha values in present study ranged from .67 to .90 at pre-intervention and .85 to .92 at post-intervention. All subscales were above .70, indicating good internal consistency for this sample, except for pre-test MG-A and MG-M imagery scores which were just below the acceptable cut-off level at .67 and .68, respectively.

Manipulation check. An Imagery Assessment Questionnaire (IAQ) was used to check for adherence to the intervention. The IAQ was adapted from a measure originally developed to assess imagery use by youth soccer players undergoing a CG imagery intervention (Munroe-Chandler et al., 2005). Best practices for imagery interventions suggest that researchers should monitor athletes' experiences with the imagery scripts to ensure that they are adhering to the intended purpose of the intervention (Murphy, 1994). The IAQ was comprised of four questions that checked athletes' use of imagery over the previous week. 1. Are you using the imagery outlined in the script? (Yes or No). 2. In the last week, how many times did you practice the imagery script? 3. On a scale from 1 to 10 how effective was your imagery session? 4. Did you change the imagery script to suit your individual needs and if so, what did you image? For participants who indicated that they practiced the imagery script over the previous week, mean scores were calculated using the number of times they practiced the script and their ratings of how effective their imagery sessions were. Higher values indicated that participants practiced

the scripts more often and found them more effective. Data collected with the IAQ was descriptive in nature and used to help explain the results of the intervention.

Procedure

Once the study was approved by Western University's Research Ethics Board, the head coach of the men's and women's varsity curling teams was contacted via e-mail to obtain access to recruit the athletes to participate in the intervention. The researcher then set up a time to go to each team's practice to explain the study to the athletes. Each athlete individually completed baseline questionnaires (i.e., Demographic Questionnaire, MIQ-R, and SIQ) and completed the CSAT. Following the final imagery session, athletes completed post-intervention evaluations of their imagery ability, imagery use, and strategy ability.

Imagery intervention. Guided imagery sessions took place over a six-week period prior to athletes' regularly scheduled team practices at the local curling club. Athletes were instructed to arrive 20 minutes early to meet with the researcher. Each imagery session lasted approximately 10 to 15 minutes and took place in a room just outside the ice surface. Prior to each imagery session, the athletes filled out a shortened version of the SIQ and the IAQ to record their imagery use during the previous week (only the SIQ was administered prior to the first imagery session). Once the questionnaires were completed, the researcher had each athlete relax by getting in a comfortable position and closing their eyes. The researcher proceeded to read the imagery script to the athletes, having them visualize the scenario. Each imagery script was based upon different tactical scenarios similar to those that would appear in the strategy assessment that athletes completed at baseline and post-intervention. The scripts

provided details regarding the background information for each scenario (i.e., score of the game, end being played, last rock advantage, which player was throwing, and how many rocks remained to be played). The script also had athletes imagine the configuration of rocks in the house (i.e., playing area), as well as the outcomes of playing each of the provided shot options. Following the imagery session, each athlete was given a copy of that week's imagery script to take home and practice on their own.

Results

Strategy Ability

See Figure 1 for a comparison of the percentage of correct responses (i.e., response accuracy; left) and response time, for correct responses only (right), across the intervention. Overall, the athletes' accuracy did not change significantly over the course of the intervention ($t_{(10)} = 0.21, p = .839$). At baseline, the average number of correct responses on the strategy assessment was 10.45 out of 12 (87.88%) while the average

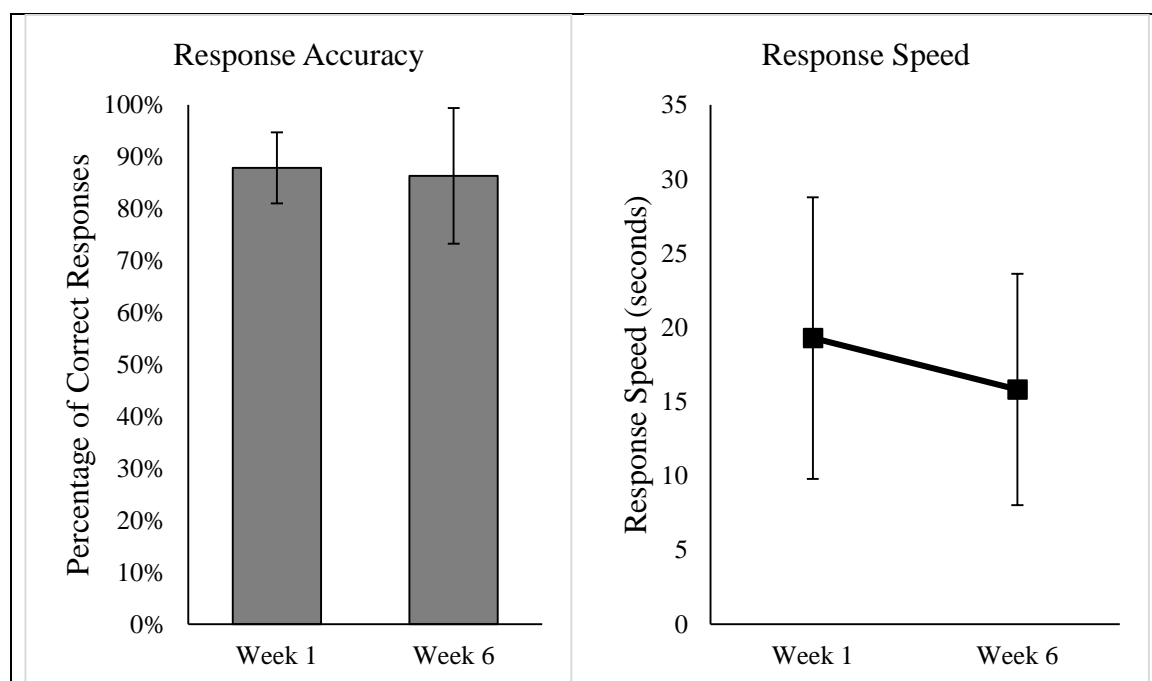


Figure 1 Changes in strategy ability from baseline to post-intervention

* $p < .05$

number decreased slightly to 10.36 out of 12 (86.36%) at post-intervention. Hedge's g effect size was .14, indicating a small effect (Cohen, 1988). A change was noted when examining athletes' response time for correct responses only. Their average response time of 19.29 seconds at baseline was reduced to 15.82 seconds at post-intervention. A paired samples t -test indicated that this improvement was significant, $t_{(10)} = 3.09, p < .05$. Hedge's g effect size was .39, indicating a small to medium effect size (Cohen, 1988).

Imagery Ability and Use

All 11 athletes had adequate imagery ability as their subscale scores were above 4 on the 7-point Likert scale (Munroe-Chandler et al., 2012). Participants who score at the midpoint on the subscales (i.e., 4 out of 7) are considered to have a moderate imagery ability (Smith, Wright, Allsopp, & Westhead, 2007). It is important to check that participants have at least a moderate imagery ability to ensure that they are able to follow the imagery scripts effectively. Values for all subscales increased from baseline to post-intervention (see Table 3), albeit marginally for visual imagery ability. Paired t -tests calculated between baseline and post-intervention showed significant increases in

Table 3
Means and standard deviations of imagery ability and imagery use

| Measure | Baseline | Post-Intervention | Paired t -test |
|-----------------------------|-------------|-------------------|------------------|
| Imagery Ability | | | |
| Visual imagery ability | 6.32 (0.83) | 6.34(0.82) | 0.25 |
| Kinesthetic imagery ability | 5.93 (0.93) | 6.34(0.76) | 3.01* |
| Imagery Use | | | |
| CG imagery | 5.12(1.06) | 5.80(1.09) | 2.98* |
| CS imagery | 5.19(1.14) | 6.03(1.04) | 2.09† |
| MG-A imagery | 4.71(1.19) | 5.14(1.28) | 1.28 |
| MG-M imagery | 5.35(1.02) | 6.14(0.97) | 2.42* |
| MS imagery | 4.65(1.65) | 5.35(1.77) | 2.14† |

Note: CG = cognitive general; CS = cognitive specific; MG-A = motivational general-arousal; MG-M = motivational general-mastery; MS = motivational specific.

* $p < .05$; † $< .10$

kinesthetic imagery ability, CG imagery use, and MG-M imagery use ($p < .05$). CS imagery use and MS imagery use showed trends towards significance ($p = .064$ and $.058$, respectively), while visual imagery ability and MG-A imagery use did not show a significant increase.

Figure 2 shows the subscale scores for CG imagery and CS imagery at baseline and post-intervention, as well as the data collected from the shortened SIQ throughout the intervention. Four athletes were absent at Week 5 and thus did not complete the shortened SIQ. The mean CG and CS subscale scores were calculated using the data from the seven athletes who were present that week. No other absences occurred.

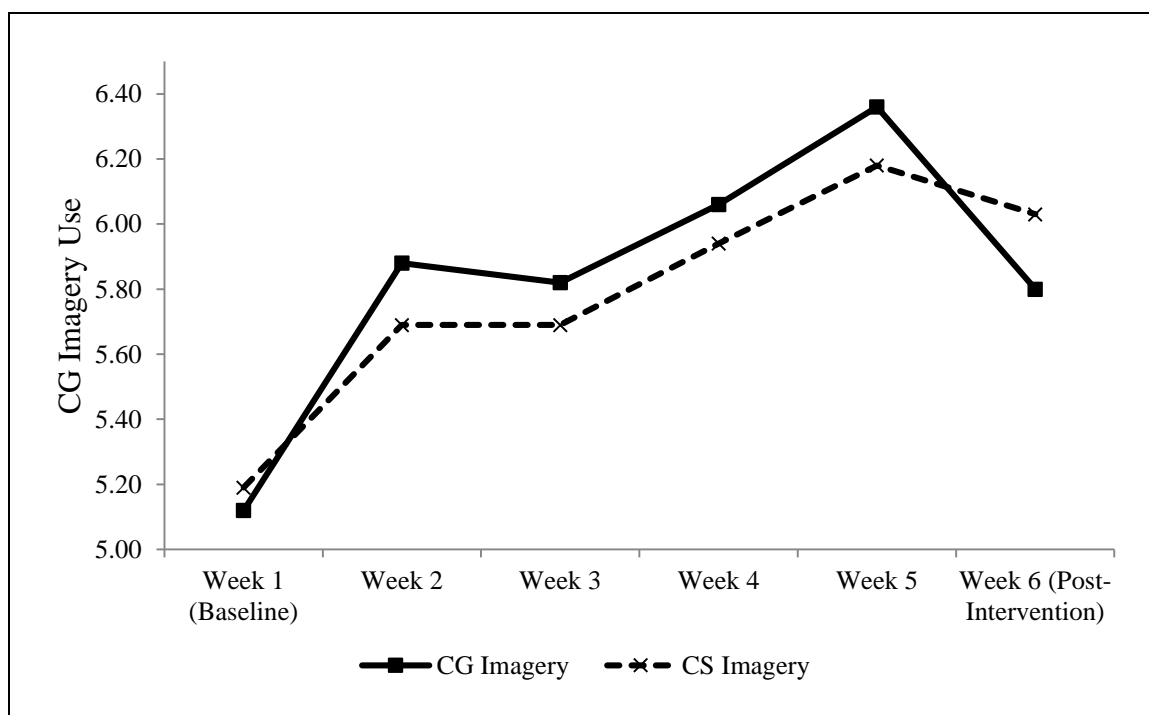


Figure 2 Changes in CG and CS imagery use from baseline to post-intervention
Note: Only seven athletes completed the shortened SIQ at Week 5.

Intervention Adherence

Analysis of the athletes' responses to the IAQ during Weeks 2 to 5 indicated an overall poor adherence to the imagery program outside of sessions with the researcher.

While the majority of athletes indicated following the imagery script outside of practice, the average number of times per week was only 1.14 ($SD = 0.95$), ranging from 0 to 3 times per week. This average was calculated across all athletes for the four-week period in which imagery adherence was tracked. On average, athletes gave their imagery practice an overall effectiveness rating of 6.85 out of 10 ($SD = 2.52$). When examining specific changes that were made to the imagery scripts, the majority of athletes visualized themselves making the shot rather than standing in the house watching their teammate throw the shot (i.e., incorporating CS imagery). Other athletes incorporated different scenarios that were encountered during recent games into their imagery practice.

Discussion

The purpose of this study was to determine if a six-week imagery intervention could improve the accuracy and speed of varsity curlers' tactical decision-making in game situations. A secondary purpose was to examine whether curlers significantly improved their CG imagery use and imagery ability over the course of the intervention. It is extremely important for curlers to make both accurate and quick strategy decisions because teams are limited to 38 minutes of thinking time during a competitive 10-end game (Canadian Curling Association, 2014). Running out of thinking time forces a team to forfeit their ability to play any remaining rocks, thus potentially losing the game.

While decision-making accuracy did not show a significant improvement, decision-making speed significantly improved from baseline to post-intervention ($p < .05$). Since the curlers were experienced, they may have been focusing their efforts on improving their response time. This occurrence is common in numerous sports. For example, Beilock, Bertenthal, Hoerger, and Carr (2008) found that expert golfers were

able to improve their response speed regardless of whether they were asked to focus on accuracy or speed. Experienced athletes who spend more time developing their decision-making skills improve their capacity to process and store information through their WM, a phenomenon documented in sports with strategies similar to curling, such as chess (Simon & Chase, 1973) and snooker (Abernathy, Neal, & Koning, 1994). Having advanced decision-making skills enables athletes to make tactical decisions quickly as they are likely to have encountered a similar situation previously (Simon & Chase, 1973). As athletes gain more experience in their sport, they begin to rely more on intuitive decision-making based on prior experiences instead of deliberations, which requires more time and more conscious effort (Raab & Laborde, 2011). At the other end of the spectrum, younger and non-elite curlers may be forced to choose whether to focus on improving accuracy or speed, as their lack of experience limits their ability to focus on both (Beilock et al., 2008). In curling, the choice for younger and non-elite curlers would most likely be to focus on making the correct decision. This decision-making process is probably controlled in large part by the brain's WM (Baddeley & Hitch, 1974; Furley & Memmert, 2010) and future researchers might examine this possibly through the use of techniques such as fMRI.

Over the course of the intervention, curlers significantly increased their use of CG imagery and MG-M imagery, as well as kinesthetic imagery ability ($p < .05$). This increase is likely because the imagery scripts consisted mainly of CG imagery cues, focusing on choosing among various shot options and applying curlers' knowledge of strategy throughout various points in a curling game. Typically, the function of an image should match the intended outcome (Martin et al., 1999). However, the revised applied

model of deliberate imagery use (Cumming & Williams, 2013) suggests that athletes may assign different meanings to the same image, thus fulfilling different functions. An increase in MG-M imagery (i.e., confidence and focus) in the present study supports previous research that showed positive associations between imagery use and both state and trait confidence (e.g., Abma, Fry, Li, & Relyea, 2002; Callow & Hardy, 2001). In particular, curlers may use CG imagery for various functions, such as improving their strategy ability, as well as feeling more confident (i.e., MG-M; Callow & Hardy, 2001).

Athletes' imagery abilities usually improve as they employ imagery more often (Vadocz, Hall, & Moritz, 1997), which is consistent with the findings in the present study. Improvements in visual and kinesthetic imagery ability occur at different times, depending on the amount of experience an athlete has in their sport. Athletes with less experience will improve their visual imagery ability first, while athletes with more experience and good visual imagery abilities will show improvements in their kinesthetic imagery ability (Cumming & Ste-Marie, 2001; Rodgers, Hall, & Buckolz, 1991). This finding was echoed in the present study; visual imagery ability stayed at a consistently high level, while kinesthetic imagery ability improved from baseline to post-intervention. Given that the population consisted of experienced curlers who competed at a varsity level, this finding makes sense.

Despite these results, there are some limitations to note. The lack of curlers' adherence to the imagery training program on their own time is somewhat discouraging. Researchers have shown, however, that imagery can have performance effects with as little as one repetition per week, although more practice is usually preferable (Wakefield & Smith, 2011). Future research should explore ways to make imagery training easier for

athletes, such as providing an audio recording instead of a written script to improve the standardization of the imagery training (e.g., Smith & Holmes, 2004) or providing detailed instructions to athletes specifying how to engage in imagery practice on their own (e.g., Orlick, 2008). Although imagery perspective was not a consideration in the imagery scripts in the present study, researchers may want to ensure that athletes are using their preferred visual imagery perspective (i.e., internal or external). As such, screening measures such as the Movement Imagery Questionnaire-3 (MIQ-3; Williams et al., 2012) should be used to test athletes' abilities to use both internal and external visual imagery perspectives. Future research should also employ different experimental designs to examine the effects of CG imagery training. A multiple baseline single-subject design focuses on individual responses to an intervention rather than group analyses, which is important in applied research (Hrycaiko & Martin, 1996). Single-subject multiple baseline designs have the added benefit in that each participant acts as their own control group, thus all athletes receive the intervention (Hrycaiko & Martin, 1996). In addition, more work is needed to refine the CSAT to ensure that the scenarios are appropriate for the experience levels of the targeted curlers (i.e., avoiding a potential ceiling effect as seen in the present study), as well as determine the CSAT's reliability and validity (e.g., test-retest reliability and discriminant validity) as a measure of strategy ability.

Nonetheless, the present study hosts a number of strengths. A manipulation check was included to determine whether the curlers were actually practicing the scripts outside of the weekly sessions with the researcher (Murphy, 1994). The manipulation check was also useful in determining that the athletes were modifying the scripts for their own use (i.e., reviewing past games, incorporating CS imagery). The present study provides

preliminary support for the CSAT as a useful assessment tool of tactical decision-making in curling. The development of a reliable and valid assessment tool can help researchers determine the effects of CG imagery training on both strategy performance (i.e., response accuracy and response time) and overall athletic performance (Westlund et al., 2012).

Conclusion

The present study provides preliminary support that CG imagery training can improve tactical decision-making (i.e., response time) in curling. These findings can be used by researchers and sport psychology consultants in applied settings to help experienced curlers improve their decision-making speed as well as their ability to select shots to play in various situations. Given that CG imagery is relatively easy to use, curlers can employ this type of imagery to prepare for different game situations they may encounter leading up to a competition or immediately before a game as part of their pre-game routine. Continually rehearsing different game scenarios can increase curlers' stored memories of situations that can easily be recalled in game situations. These findings could be extended to other sports with similar strategy decision-making processes (e.g., billiards or golf; Mann, Williams, Ward, & Janelle, 2007). Sport-specific cognitive and perceptual training via CG imagery may help athletes improve their ability to recognize and recall tactical situations in order to make more efficient decisions (e.g., Abernathy et al., 1994; Simon & Chase, 1973).

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Study 3

The Effects of Cognitive General Imagery Training on Decision-Making Abilities: A Single-Subject Multiple Baseline Approach²

Imagery is a psychological skill frequently examined in the sport psychology literature (Short et al., 2002). Imagery involves using the senses to create or re-create an experience in the mind (Vealey & Greenleaf, 2006). According to Hall, Mack, Paivio, and Hausenblas (1998), athletes use imagery for a variety of cognitive and motivational functions, such as the rehearsal of sports skills (cognitive specific [CS] imagery) and strategies (cognitive general [CG] imagery), increasing confidence and mental toughness (motivational general-mastery [MG-M] imagery), managing arousal and anxiety (motivational general-arousal [MG-A] imagery), and picturing sport-related goals (motivational specific [MS] imagery). Martin, Moritz, and Hall (1999) argued that athletes should use the function of imagery that best matches their desired cognitive, affective, or behavioural outcome. For example, athletes should use CG imagery if they would like to enhance their execution of strategies during actual game situations.

Psychological interventions are frequently conducted in sport to determine the effects of various mental skills, such as imagery, on performance. Most interventions using imagery have focused on the improvement of sports skills and overall performance (e.g., CS imagery; Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012) or motivational functions such as confidence (e.g., MG-M imagery; Callow, Hardy, & Hall, 2001). Researchers have argued that the focus on certain imagery functions has caused researchers to miss other ways that imagery can be used to improve performance (Martin

² A version of this study will be published in the *Journal of Applied Sport Psychology* (in press).

et al., 1999). For example, case studies and anecdotal evidence suggest that athletes use CG imagery in a variety of sports, such as artistic gymnastics and canoe slalom racing (White & Hardy, 1998). However, the small number of interventions conducted using CG imagery have produced mixed results.

Munroe-Chandler, Hall, Fishburne, and Shannon (2005) conducted a six-week CG imagery intervention aimed at improving the execution of three soccer strategies in youth soccer players. Expert ratings of the athletes' strategy execution during games noted a small increase in the performance of one of the selected strategies, although this increase was not significant. Researchers were unable to analyze the other two strategies because they did not occur often enough during game play. These results suggested that a weak relationship was present between CG imagery use and the execution of the soccer strategies. Guillot, Nadrowska, and Collet (2009) conducted a six-week CG motor imagery intervention aimed at improving the learning and performance of strategies in basketball. Three different game plans were chosen: one was practiced mentally and physically over a six-week period, a second game plan was only practiced physically, and a third game plan was not practiced at all. Following the six weeks, coach and player ratings of the three game plans indicated that the game plans that were practiced both mentally and physically, as well as just physically were performed significantly better than the game plan that was not practiced at all. There were no significant differences between the game plans that were practiced mentally and physically, and just physically. These findings suggest that CG imagery in addition to physical practice might be useful in improving the learning and performance of basketball strategy.

Westlund, Pope, and Tobin (2012) conducted a review of the CG imagery literature. They concluded that a potential reason for the lack of CG imagery interventions might be the difficulty in measuring strategy performance because strategy performance is not easily controllable in real-world situations (e.g., Munroe-Chandler et al., 2005). Thus, researchers must search for a balance between ensuring that their intervention has ecological validity, yet still provide sufficient opportunities to assess strategy performance. Furthermore, research on decision-making in sport has shown that expert athletes have superior sport-specific cognitive and perceptual abilities compared to less experienced athletes (e.g., Abernathy, Neal, & Koning, 1994). Thus, using a sport-specific assessment of decision-making abilities is necessary to measure strategy performance in the targeted sport.

Traditionally, many sport psychology interventions, including the ones described above, are conducted and analyzed using combined mean scores from all participants (Bryan, 1987). This focus on mean-level analyses can be problematic because individual trends and behaviour can be missed, which are important when assessing individual athletes in applied sport settings (Hrycaiko & Martin, 1996). Therefore, the use of single-case or single-subject designs are encouraged to provide evidence-based interventions for sport psychologists working with athletes (Barker, Mellalieu, McCarthy, Jones, & Moran, 2013). One type of single-case design that has gained momentum in the sport psychology literature is the single-subject multiple baseline design. The use of single-subject multiple baseline designs has been encouraged by researchers because it can demonstrate external validity of the independent variable being tested (Hrycaiko & Martin, 1996). Other benefits of the single-subject multiple baseline design include:

continuous measurement of the dependent variable, all participants receive the intervention, and the scientific and practical evaluations of the intervention effects (Hrycaiko & Martin, 1996).

Single-case design studies that have used imagery training as an independent variable have focused mainly on improving motivational outcomes (e.g., Callow et al., 2001) or overall performance (e.g., Marlow, Bull, Heath, & Shambrook, 1998), as dependent variables. More specifically, researchers have used multiple baseline methodology to show athletes can use imagery to improve their self-efficacy (O, Munroe-Chandler, Hall, & Hall, 2014), modify their perceptions of pre-competition anxiety (Mellalieu, Hanton, & Thomas, 2009), and increase both flow and perceived performance (Pain, Harwood, & Anderson, 2011). Callow and colleagues (2001) examined the effects of MG-M imagery use on the confidence levels of four elite junior badminton players. Following multiple-baseline methodology, each of the athletes completed a minimum four-week baseline phase and then sequentially began a bi-weekly imagery training program that lasted three weeks. Following the completion of the imagery training, researchers continued to monitor the athletes' confidence levels before each match until they reached 21 weeks. Overall, three out of the four athletes showed an increase in their confidence levels as a result of the imagery intervention.

To date, there are no single-subject multiple baseline interventions focusing on CG imagery and strategy performance. As mentioned earlier, group-level interventions have shown mixed results regarding the effects of CG imagery on performance (e.g., Guillot et al., 2009; Munroe-Chandler et al., 2005). The purpose of the present study was to examine the effects of a CG imagery intervention on the strategy performance of

curlers using single-subject multiple baseline methodology. It was hypothesized that curlers' strategy performance, measured by their response accuracy and response time (i.e., decision speed), would improve as a result of the imagery intervention.

Method

Participants

Four curlers were originally recruited to participate in the present study. One participant dropped out part-way through the imagery training, thus the final data analysis was conducted with three participants. All three participants were female, with an average age of 19.33 ($SD = 3.06$) and 12.00 years of curling experience ($SD = 5.29$). Two of the curlers indicated playing the vice position (i.e., the player who throws the fifth and sixth rocks of the end and directs the play in the house during the skip's shots), one for the past two years and the other for the past five years. The third curler indicated playing lead (i.e., the player who throws the first two rocks of the end and sweeps the other six rocks) for the past 18 years. Although one participant indicated having experience curling at the provincial level, all of the curlers were currently playing at a regional level, thus fitting the category of a 'basic' athlete according to the taxonomy advanced by Baker, Wattie, and Schorer (2015).

Measures

Tactical decision-making. The Curling Strategy Assessment Tool-2 (CSAT-2), developed in Phase 2 of Study 1, was used to assess participants' strategy performance (i.e., response accuracy and response time) throughout the intervention. It is computer-based, and tests participants' ability to make correct strategy decisions in the shortest amount of time. Making accurate and efficient decisions is important in curling; curlers

need to decide on the best strategy to employ in a given situation, and there is only a limited amount of time available to make strategy decisions throughout a game. If a team runs out of time, they forfeit their ability to continue to play any remaining rocks and could lose the game. The CSAT-2 works by initially showing participants the background information for one of 104 possible scenarios (i.e., score of the game, end being played, whether their team has last rock advantage, who is about to throw, how many rocks remain, and the type of strategy being used). After a brief delay, participants are shown a picture of the playing area and four shot options, out of which they select the most correct shot to call in that scenario. Participants are scored based on how many times they selected the correct shot for a given scenario (i.e., response accuracy), as well as how long it takes them to make a decision (i.e., response time). Response times for scenarios where incorrect shots are selected were not included in the analyses.

Imagery ability. Curlers' visual and kinesthetic imagery abilities were screened prior to the intervention to determine if they possessed ability levels sufficient for participation in the intervention. This was accomplished using the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997). The MIQ-R consists of eight items, with four items assessing visual imagery ability and four items assessing kinesthetic imagery ability. For each item, participants are instructed to physically perform a simple movement (e.g., "bend at your knees and jump in the air as high as you can"), visualize performing that same movement, and rate how easy it was to see (visual ability) or feel (kinesthetic ability) the movement on a 7-point scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). Internal consistency reliability from the present study was .91 for visual imagery and .74 for kinesthetic imagery, indicating good

internal consistency for this sample. Factorial validity has supported the distinction of visual and kinesthetic imagery ability as separate, but related constructs (Monsma, Short, Hall, Gregg, & Sullivan, 2009).

Imagery use. Imagery use was assessed using the Sport Imagery Questionnaire (SIQ; Hall et al., 1998). The SIQ asks athletes to rate how often they use each of the five functions of imagery on a 7-point scale ranging from 1 (*rarely*) to 7 (*often*). In the present study, four of the subscales exhibited acceptable internal consistency at pre-intervention: .94 (CG imagery), .97 (CS imagery), .85 (MG-A imagery), and .89 (MG-M imagery). The MS imagery subscale showed a poor reliability level at .44 and was not included in the analyses. Predictive and factorial validity of the five imagery functions has been supported previously (Hall et al., 1998; Hall, Stevens, & Paivio, 2005).

Imagery manipulation check. Murphy (1994) argues for the inclusion of a manipulation check to increase the validity of imagery interventions by monitoring athletes' adherence to the purpose of the intervention. Thus, the Imagery Assessment Questionnaire (IAQ) used by Munroe-Chandler and colleagues (2005) was used in the present study. The IAQ is composed of four questions regarding athletes' use of imagery over the previous week: 1. Are you using the imagery outlined in the script? 2. In the last week, how many times did you practice the imagery script? 3. On a scale from 1 to 10, how effective was your imagery session? 4. Did you change the imagery script to suit your individual need and if so, what did you image?

Social validation. A Social Validation Questionnaire was developed for the present study to provide additional support for the effectiveness of the intervention. Following the completion of the 18-week intervention, participants were asked about

their experiences with the imagery training and strategy performance assessments. It allowed participants to reflect on their experiences and potentially provide an explanation for why they may or may not have found the intervention to be effective.

Procedure

After receiving ethical clearance from Western University's Research Ethics Board, the curlers were recruited from a local curling club to participate in the present study. Participants began meeting with the primary researcher once weekly to complete the CSAT-2. Week 1 entailed the collection of demographic information, imagery ability, imagery use and 10 items on the CSAT-2. Following this initial session, participants completed only six items on the CSAT-2 at subsequent sessions. The items tested were chosen randomly from the item pool of 104 scenarios. This was done in an effort to include a variety of strategic situations, decrease the amount of repetition, and to avoid possible confounding effects of athletes becoming familiar with certain scenarios. Starting at week 5, athletes were randomized to sequentially begin the eight-week imagery training program. The progression was as follows: Participant A began at week 5, Participant B began at week 6, Participant C began at week 7, and Participant D began at week 8. Each athlete progressed through the imagery training program during which she would continue to meet with the researcher once per week. Participant C dropped out part-way through the imagery training program, thus their data was removed from the analyses. During each meeting, the athletes would first complete a shortened version of the CSAT-2, followed by imagery training, where the researcher would read the imagery script aloud for the athletes to follow. Each imagery script was based on a scenario that curlers could encounter on the CSAT-2. Following a brief relaxation script, the curlers

were first provided with background information regarding the scenario (e.g., score, end being played). Next, the curlers were prompted to image the location of all rocks in the playing area and then asked to image four potential shot outcomes. Finally, they were asked to choose the correct shot and see that shot being executed perfectly. In order to standardize the intervention (Kratochwill et al., 2010), all curlers received the same imagery script each week to ensure they were practicing identical strategy situations throughout the intervention phase. The weekly imagery training sessions lasted approximately 15 minutes. Athletes were provided with a copy of the imagery script to practice on their own over the upcoming week. Athletes' individual imagery practice was monitored at the following meeting with the researcher using the IAQ, which was administered at the start of the meeting. Following the completion of the eight-week imagery training program, athletes continued to meet with the researcher to complete the CSAT-2 until Week 18, at which time they completed the SIQ, a 10-item version of the CSAT-2 and the social validation questionnaire.

Data Analysis

One method commonly used in the literature to analyze data in single-subject multiple-baseline designs is visual analysis of graphical performance data for each participant. Guidelines put forth by Kratochwill and colleagues (2010) for conducting visual analyses were utilized in the present study. According to Kratochwill and colleagues, six features need to be assessed in the graphical data, both individually and collectively: a) level, b) trend, c) variability, d) immediacy of effect, e) proportion of overlap and f) consistency of data across phases. Level refers to the mean score within each data phase (e.g., baseline and intervention). Trend refers to the slope of the line of

best fit for the data within each phase. Variability refers to the range or standard deviation of data around the mean of each phase. Immediacy of effect refers to the change in mean between phases. This was assessed by taking the mean of the last three data points of the baseline phase and the first three data points in the intervention phase. Proportion of overlap refers to the percentage of data that overlaps data from the previous phase (i.e., how many data points in the intervention phase overlap with data points in the baseline phase). Finally, consistency of data across phases requires the examination of data from all phases within the same condition, looking for consistency (e.g., the baseline phases for all three participants).

Despite its frequent use in the literature, visual analysis has been criticized for its lack of rigorous psychometric properties (Gage & Lewis, 2013). To overcome this, statistical analyses were conducted to supplement the visual analysis; percentage of non-overlapping data points (PND; Scruggs & Mastropieri, 1998) and standardized mean difference (SMD_{all} ; Rosnow & Rosenthal, 1996). PND refers to the proportion of data points in the intervention phase above the highest point in the baseline phase. SMD_{all} is an effect size calculation, determining the differences between the baseline and intervention phases. The following guidelines put forth by Martin and Pear (1996) were used to interpret the results and determine whether an intervention effect occurred: a) trend of the baseline phase being stable or in an opposite direction of the predicted intervention effects, b) the effect was replicated within and across participants, c) a small percentage of overlapping data points, and d) medium to large effect size. A PND of 90% or greater indicated very effective treatment, 70%-89% indicated effective treatment, and 50% or less indicated ineffective treatment (Scruggs & Mastropieri, 2001).

It must be noted that results of PND analyses should be approached with caution, as they can have high levels of errors (Wolery, Busick, Reichow, & Barton, 2010). A SMD_{all} of 0.25 indicated a large effect size and 0.09 indicated a medium effect size (Cohen, 1988).

Results

Descriptive Statistics

See Table 4 for a summary of participants' demographic information and scores on the MIQ-R and SIQ at the beginning of the intervention and SIQ scores at the end of the intervention. Examining participants' individual scores for the MIQ-R, Participants A and B scored above the suggested cut-off level of 4 (out of 7), while Participant D scored at or below the suggested cut-off level (visual imagery ability = 4.00, kinesthetic imagery ability = 3.75). Since the imagery scripts focused on visual imagery, Participant D was deemed to possess adequate ability to participate in the intervention.

Table 4
Demographic information, imagery ability, and imagery use

| Variable | Participant A | | Participant B | | Participant D | |
|-------------------------|---------------|-------------------|---------------|-------------------|---------------|-------------------|
| | Baseline | Post-Intervention | Baseline | Post-Intervention | Baseline | Post-Intervention |
| Demographic Information | | | | | | |
| Age | 16 | | 22 | | 20 | |
| Years | 8 | | 18 | | 10 | |
| Curled | | | | | | |
| Position | Vice | | Lead | | Vice | |
| Imagery Ability | | | | | | |
| Visual | 6.00 | - | 7.00 | - | 4.00 | - |
| Kinesthetic | 4.50 | - | 5.75 | - | 3.75 | - |
| Imagery Use | | | | | | |
| CG | 4.33 | 5.17 | 6.67 | 6.50 | 3.00 | 4.83 |
| CS | 4.29 | 5.14 | 6.29 | 6.57 | 2.43 | 5.00 |
| MG-A | 4.33 | 5.00 | 5.33 | 5.67 | 2.33 | 4.33 |
| MG-M | 4.33 | 6.17 | 6.33 | 6.17 | 3.50 | 6.17 |

Note: CG = cognitive general; CS = cognitive specific; MG-A = motivational general-arousal; MG-M = motivational general-mastery.

Subscale scores on the SIQ increased from baseline to post-intervention for Participants A and D. Participant B saw slight increases in her CS and MG-A imagery use, while CG and MG-M imagery use decreased slightly. Because Participant B reported the greatest frequency of imagery use at baseline, it makes sense that her imagery use did not increase to the same extent as the other two participants, as their frequency of imagery use was much lower at the start of the intervention.

Intervention Effects

Strategy performance data were plotted for each participant across the baseline and intervention phases for response accuracy and response time. An effective intervention is indicated by an increase in response accuracy and a decrease in response time from baseline to the intervention. See Table 5 for the level, variability, trend, and immediacy of effect for both response accuracy and response time. According to

Table 5
Visual analysis of strategy performance

| Response Accuracy (%) | | | | | |
|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|---------------------|
| Level and Variability | | | Trend | | Immediacy of Effect |
| Participant | Baseline | Intervention | Baseline | Intervention | |
| A | 44.67 (14.06) | 55.90 (22.94) | Increasing | Increasing | Delayed |
| B | 53.33 (23.57) | 51.39 (15.01) | Increasing | Increasing | Delayed |
| D | 17.08 (17.86) | 48.00 (31.47) | Decreasing | Increasing | Immediate |
| Response Time (ms) | | | | | |
| Level and Variability | | | Trend | | Immediacy of Effect |
| Participant | Baseline | Intervention | Baseline | Intervention | |
| A | 13714.42 (2372.28) | 8164.29 (2175.10) | Decreasing | Stable | Immediate |
| B | 37026.10 (17057.24) | 17561.02 (7996.49) | Stable/ Increasing | Decreasing | Delayed |
| D | 22506.20 (4585.08) | 20616.69 (5729.71) | Increasing | Stable/ Decreasing | Delayed |

Kratochwill and colleagues (2010), three replications of effect must be noted in order for an intervention to be deemed successful. Thus, all three participants must show an intervention effect for both response accuracy and response time.

Response accuracy. Participant A's response accuracy showed an increasing trend during both baseline and intervention phases (Figure 3). Evidence of an intervention effect was noted by an increase in level, although this effect was delayed. The PND was 23% and SMD_{all} was .79, indicating no effect. Participant B also showed an increasing trend during both baseline and intervention phases (Figure 4). However, there was not much difference in level between the two phases as well as a delayed effect. PND was 8% and SMD_{all} was $-.083$, indicating no effect. Participant D showed a

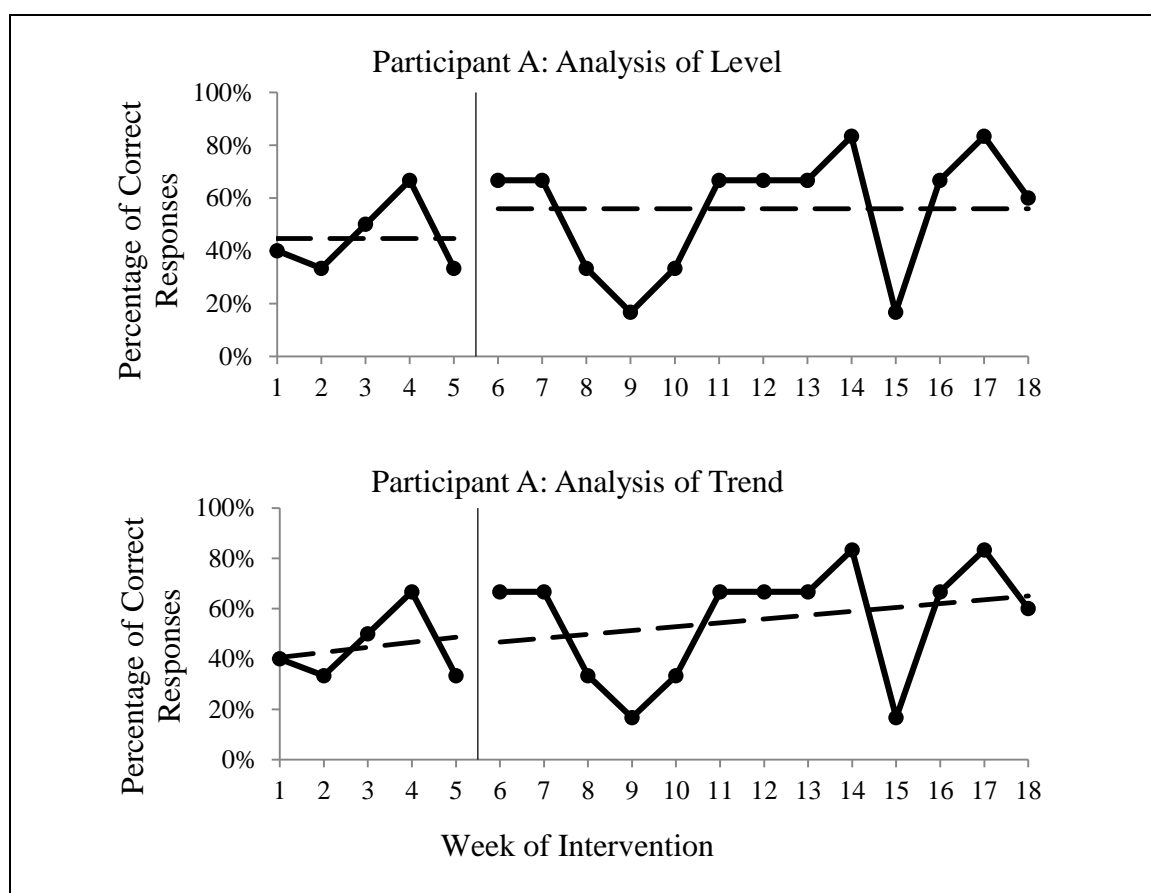


Figure 3 Level and trend of response accuracy for Participant A

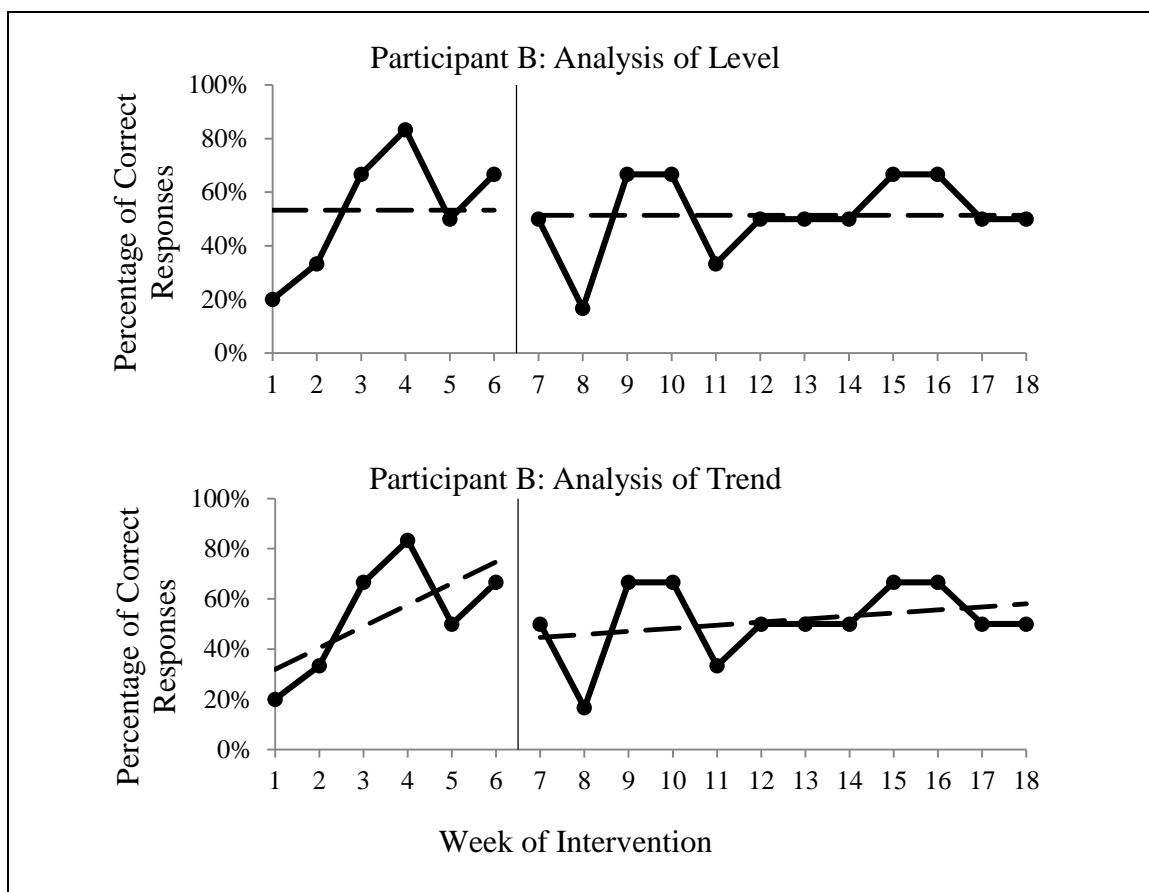


Figure 4 Level and trend of response accuracy for Participant B

decreasing trend during baseline and an increasing trend during the intervention phase (Figure 5). The level showed a moderate increase, suggesting an immediate intervention effect. Results of the statistical analyses were mixed. The PND was 40% (suggesting an ineffective treatment) and SMD_{all} was 1.72 (indicating a large effect size).

Overall, these results suggest that one out of the three participants (Participant D) showed an observable and statistical increase (according to SMD_{all}) in response accuracy. Participant A showed some evidence of a treatment effect; however, her scores were highly variable during the intervention phase and the statistical analyses did not support an effect. Participant B did not seem to show a change in response accuracy following the imagery intervention, which was confirmed by the statistical analyses.

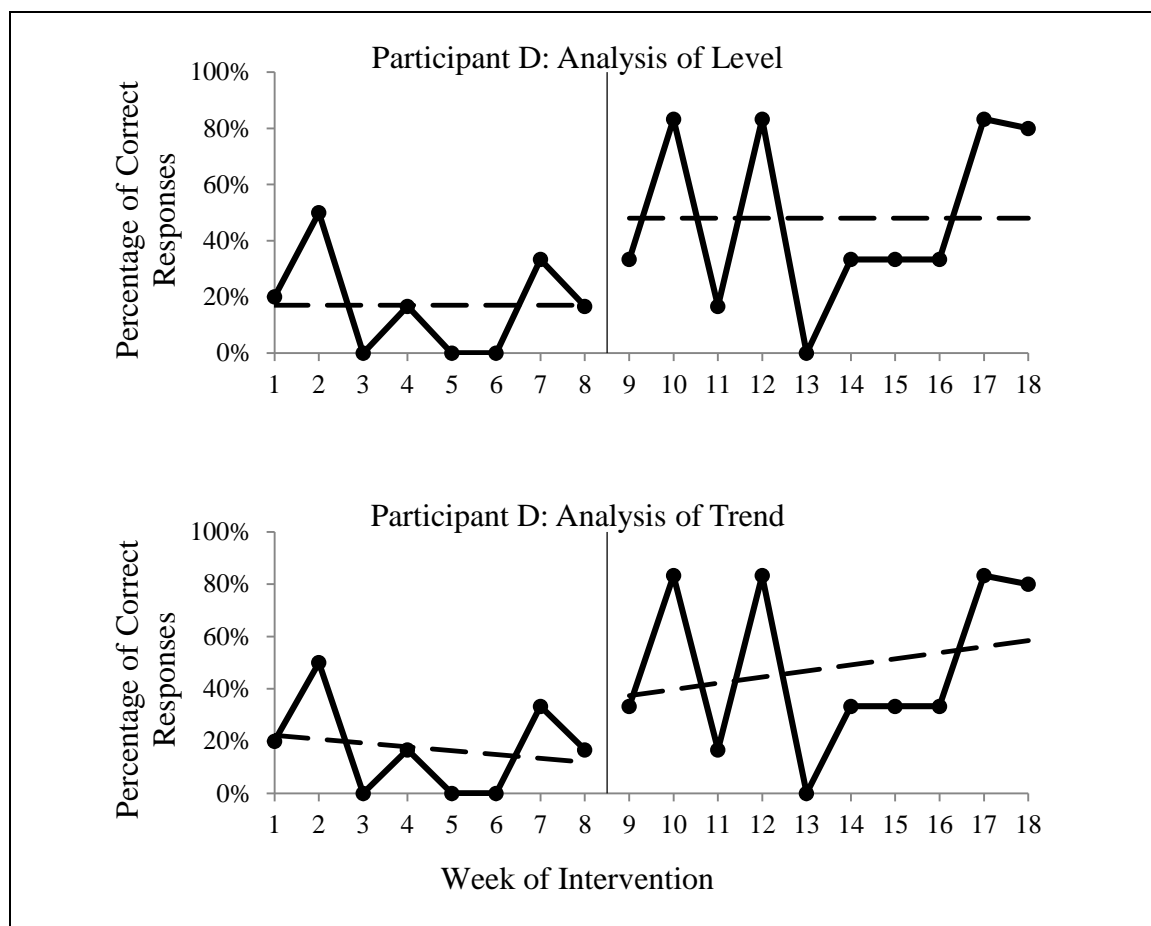


Figure 5 Level and trend response accuracy for Participant D

Response time. Participant A showed a decreasing trend at baseline and a stable trend during the intervention phase (*Figure 6*). In addition, there was a large decrease in mean (level) as well as an immediate effect. PND was 69% (just below the cut-off indicating an effective treatment) and SMD_{all} was 2.44 (indicating a large effect). Participant B showed a stable/increasing trend at baseline and a decreasing trend during the intervention phase (*Figure 7*). There was a large decrease in means between the two phases; however, the data seemed to show a delayed effect. PND was 25% (indicating an ineffective treatment) and SMD_{all} was 1.46 (indicating a large effect). Participant D showed an increasing trend at baseline and a stable/decreasing trend during the intervention phase (*Figure 8*). There a slight difference in the means of the two phases,

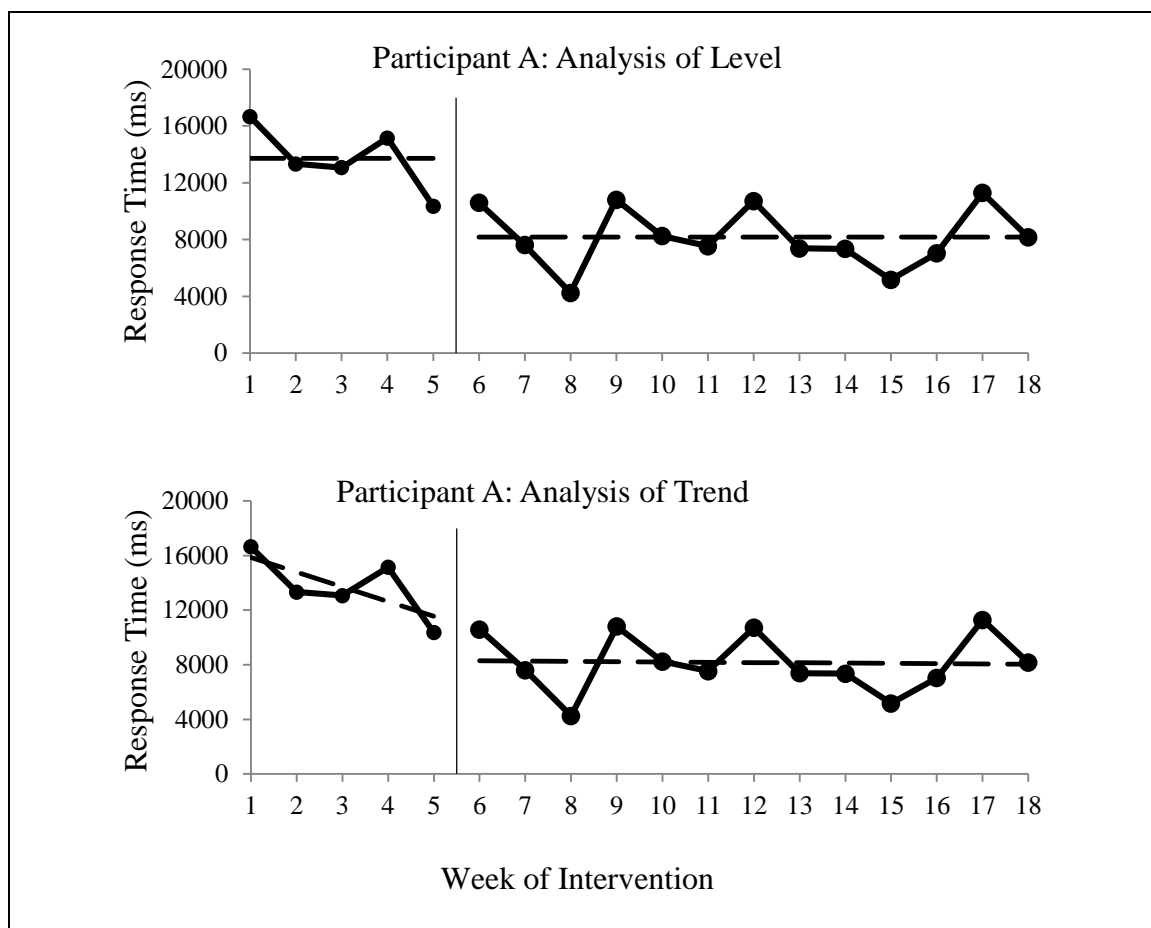


Figure 6 Level and trend of response time for Participant A

as well as a delayed effect. PND was calculated to be 21% and SMD_{all} was 0.41, indicating no effect.

Overall, two out of the three participants (Participants A and B) showed observable and statistical improvements (according to SMD_{all}) in response time. Participant D performed poorly on the CSAT during some weeks and thus did not have complete response time data. Despite this, there did not seem to be a change from the baseline phase to the intervention phase.

Social Validation Data

Examination of the social validation data that was collected at the end of the intervention provided further support for the visual and statistical analyses of the tactical

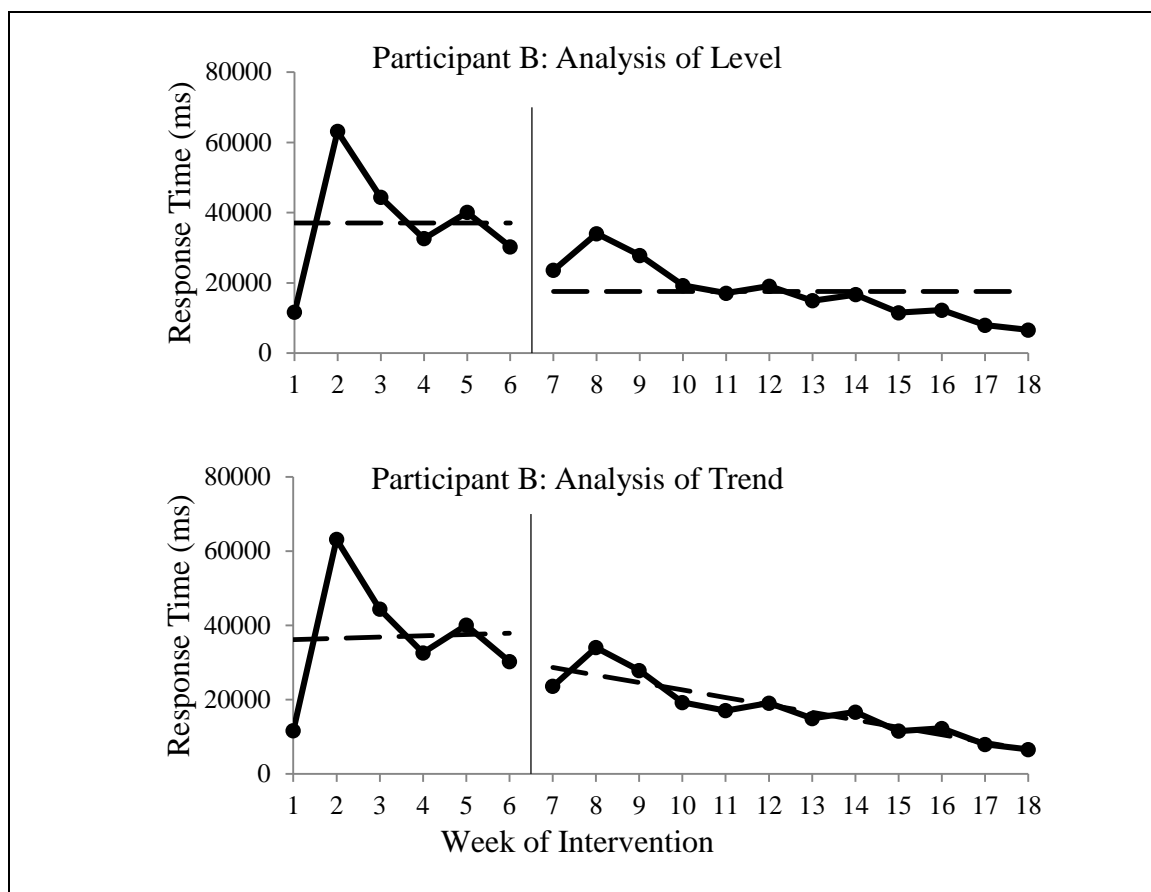


Figure 7 Level and trend of response time for Participant B

decision-making data. Overall, the results were very positive, with participants giving ratings of 6 and 7 out of 7 on their perceived importance of improving their strategy performance, whether they felt they experienced significant changes in their strategy performance, and if they were satisfied with the imagery training. Scores ranging from 5 to 7 were given in response to the participants' perceived usefulness of the imagery training. When asked why she perceived the imagery intervention to be effective in changing their levels of strategy performance, Participant A responded:

It allowed me to think about many different scenarios for a long period of time so I could fully understand why I chose the call I chose. This allowed a better

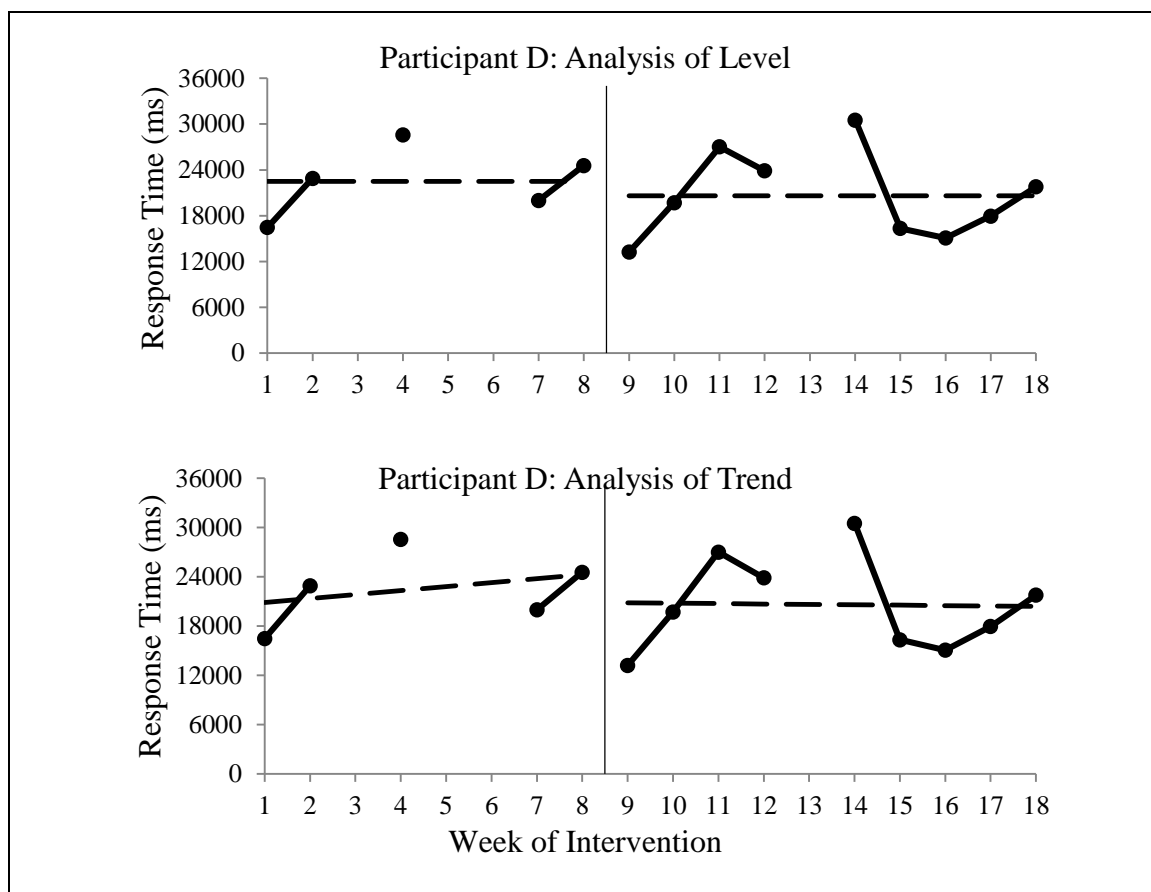


Figure 8 Level and trend of response time for Participant D

understanding of my strategy and how to play a game accordingly. The imagery sessions allowed an improvement in calling shots faster and more accurately.

Participant B echoed a similar experience:

Constantly practicing the skill made it easier to use later on. It made decision-making more efficient, and imaging a variety of situations made it easy to image mental toughness in a given game situation.

Participant D followed up her perceived effectiveness of the imagery training by stating, “I have gotten much better at imaging scenarios and situations.” Despite the participants showing varying responses to the imagery intervention, the social validation data allowed for a more in-depth look into whether the participants found the intervention useful.

Discussion

The purpose of the present study was to determine whether an eight-week imagery training program could improve the tactical decision-making abilities of curlers. It was hypothesized that the intervention would improve both the accuracy with which curlers made decisions, as well as their response time. The results indicated that one participant improved in her decision-making accuracy and two participants improved their decision-making speed, providing partial support for the hypothesis. Unfortunately, the lack of intervention effects at three different time points for each strategy performance measure reduced the experimental control of the intervention (Kratochwill et al., 2010). Thus, the results must be interpreted as a case study. Although the participants did not all show improvements in both strategy performance measures as a result of the intervention, each participant showed improvements in one of the two measures. The fact that each participant showed some improvement in one aspect of strategy performance provides support for individual responses to the imagery intervention, which may have been missed by a group-level analysis (Hrycaiko & Martin, 1996). The present findings support previous research indicating that athletes' use of CG imagery can benefit strategy performance (Guillot et al., 2009; White & Hardy, 1998).

Response Accuracy

Visual and statistical analyses of the participants' response accuracy across the 18-week intervention period, in addition to their feedback provided support that the CG imagery training was indeed effective for Participant D, but not for Participants A and B. During Week 1, Participant D had the lowest imagery ability scores and did not report using imagery very often compared to Participants A and B. Given Participant D's

relative lack of experience, the imagery training program provided her the opportunity to use imagery more often and become better at imaging the various strategy situations. In addition, it is likely Participant D sacrificed decision speed in order to focus on visualizing the scenarios and choosing the appropriate shot option while completing the CSAT. This trade-off between accuracy and speed is experienced by athletes in many sports. Beilock, Bertenthal, Hoerger, and Carr (2008) found that novice golfers performed better when focusing on accuracy (choosing the correct line) instead of speed when performing golf putts.

Contrary to Participant D, Participants A and B exhibited moderate to high imagery abilities, and reported using imagery more often at the start of the intervention. In addition, their response accuracy scores during the baseline phase were already moderately high, averaging 60%. This moderate score level would be expected given the participants' skill levels (Mann, Williams, Ward, & Janelle, 2007). Thus, it is likely Participants A and B were less concerned about improving their levels of accuracy and focused on improving their decision speed, or response time.

Response Time

When considering participants' response time, the findings are reverse of what was found in regards to response accuracy, which is in line with our argument of a trade-off between response accuracy and decision speed. Participants A and B significantly improved their response time as a result of the imagery training, while Participant D did not show any significant improvement. Qualitative data collected following the intervention highlighted how the imagery training helped Participants A and B improve their ability to make decisions more quickly, as they were able to visualize the scenarios

and various shot options more easily. In curling, it is not only important to make the best tactical decisions, but these decisions need to be made quickly as time limitations per game are strictly enforced. Athletes who undergo perceptual training of anticipation skills have shown improvements in response time while maintaining, but not improving their response accuracy (Williams, Ward, & Chapman, 2003). In addition, when both accuracy and speed are components of a task, athletes who already perform accurately can focus their efforts on response speed (Beilock et al., 2008).

Strengths, Limitations and Practical Implications

This study was the first to examine the effects of CG imagery training on strategy performance in a sport using a single-subject multiple-baseline methodology. Overall, the strategy performance improvements in response to the CG imagery training program showed considerable promise. Another strength of this study was use of the CSAT-2. One reason for the lack of CG imagery interventions is the issue of measuring sport strategy performance (Westlund et al., 2012). The CSAT-2 has proven to be an effective way to assess strategy performance in curling. Moreover, the CSAT-2 not only assesses whether the most appropriate strategy was chosen for a given situation, it also considers how rapidly that decision was arrived at.

Despite these strengths, there are also some limitations to note. First, the sample consisted of only female curlers. It would be interesting to repeat this intervention using a male sample and compare the results to determine if any gender differences exist in response to the imagery training. Second, it may have been more effective to provide participants with audio versions of the imagery scripts to practice on their own. Research has suggested that imagery training is more effective when delivered via audio or video

mediums as it makes the experience more accurate (Smith & Holmes, 2004). In addition, providing audio scripts would have made the imagery training more similar between participants' at-home practice and the laboratory sessions. Despite using the same imagery scripts for each curler to ensure standardization of the imagery training (e.g., Kratochwill et al., 2010), future researchers should consider adjusting the scripts to fit the individual characteristics of each curler. For example, curlers who play the lead or second positions would have a different view of the playing area compared to curlers who play the skip position. Third, the inability to demonstrate three instances of an intervention effect for both response accuracy and response time decreases the experimental control of the intervention (Kratochwill et al., 2010). This intervention should be replicated with additional participants in order to determine whether strong evidence for an intervention effect can be observed. Finally, multiple-baseline methodology requires that data points collected during the baseline stage should be stable before introducing the intervention (Hrycaiko & Martin, 1996) and this was not the case for all participants. The lack of stable baseline data in the present study also may have affected the calculation of PND, as the high degree of variability may have inadvertently decreased the number of data points in the intervention phase that overlapped with the baseline (Kratochwill et al., 2010). This was noted in Participant B's Week 1 response time data as it caused the PND to be 25%. Recalculation of the PND without this potential outlier changes the PND to 91.67%. The presence of this outlier could be attributed to the fact that Participant B's response accuracy during Week 1 was only 20%. Thus, she may have been rushing through the scenarios focusing on response time, without paying attention to response accuracy. It should be noted that the inclusion of

PND calculations has been met with criticism regarding its statistical properties (e.g., Wolery et al., 2010), thus researchers should be cautious when using PND data to interpret intervention effects. However, the inclusion of visual inspection and the effect size calculations aimed to overcome this potential limitation.

There is considerable sport research demonstrating that imagery interventions can increase variables such as confidence (Callow et al., 2001) and self-efficacy (O et al., 2014), as well as improve overall performance and flow states (Blair, Hall, & Leyshon, 1993; Nicholls, Polman, & Holt, 2005). Moreover, case studies and anecdotal research (e.g., Fenker & Lambiotte, 1987; MacIntyre & Moran, 2007; Rushall, 1988; White & Hardy, 1998), as well as the study by Guillot et al. (2009) indicate that CG imagery can positively influence the learning of strategies of play, game plans, and entire routines in a variety of sports. The present study supports and extends this research showing that a CG imagery intervention can improve strategy performance in curling. Accordingly, athletes with varying levels of experience should be encouraged to use CG imagery as a means of improving their strategy performance during curling games. CG imagery can also be used immediately before a game to help curlers prepare to execute their game plans (e.g., Evans, Jones, & Mullen, 2004) or after a game to review and learn from the effectiveness of their strategy decisions (e.g., Munroe et al., 2000). In addition, curlers can benefit from using CG imagery to refine their strategy performance during the off-season when they do not have access to ice. Future research should employ CG imagery interventions to determine how CG imagery can be applied effectively in these contexts.

While both accuracy and speed are important in successful strategy performance, the trade-off that exists between accuracy and speed often forces athletes to focus on one

at the expense of the other (Fitts, 1954). However, as athletes gain more practice with a skill, their behaviour becomes automatic and the speed-accuracy trade-off no longer applies (MacKay, 1982). Thus, curlers with less experience should be directed to practice CG imagery to improve their ability to make the best tactical decisions during a game. Once they are able to make accurate strategy decisions in a variety of situations, they can then turn their attention to making those decisions as quickly as possible. Future researchers could further explore CG imagery use in curlers of differing experience levels to determine whether the speed-accuracy trade-off exists.

In conclusion, the CSAT-2 is a valuable instrument for measuring the improvement of strategy performance in curling. However, additional research is still needed to determine the effects of CG imagery on athletic performance. While researchers could apply the findings of this study to sports with similar strategy decision-making processes (e.g., billiards or golf; Mann et al., 2007), sport-specific measures of strategy performance would need to be developed in the sport(s) being targeted (Abernathy et al., 1994). Establishing reliable and valid measures of strategy performance is just the first step to unlocking the utility of CG imagery use in sport.

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Study 4

The Use of Cognitive General Imagery in Curling³

Of the various mental skills used by athletes to enhance performance, imagery is the most popular (Short et al., 2002). Imagery has been described as creating or re-creating an experience in the mind using all the senses (Vealey & Greenleaf, 2006). Athletes who use imagery deliberately tend to be more successful than athletes who do not (Cumming & Hall, 2002b). Paivio (1985) suggested that athletes' imagery use operates in a 2×2 framework; serving either cognitive or motivational functions, each operating at a general or specific level. Hall, Mack, Paivio, and Hausenblas (1998) expanded Paivio's conceptual framework to describe five imagery functions in sport: cognitive general (CG; strategies and game plans), cognitive specific (CS; sport skills), motivational general-arousal (MG-A; emotion regulation), and motivational general-mastery (MG-M; confidence, mental toughness, etc.), and motivational specific (MS; goal achievement). Researchers have used the five imagery functions as a basis to explore how to optimize the use of imagery to help athletes improve their performance. Over the past 18 years, these findings have helped paint a more comprehensive picture of imagery use in sport and its associated characteristics that promote performance.

Munroe, Giacobbi, Hall, and Weinberg (2000) developed a conceptual framework describing the four Ws of imagery use in sport: where, when, why, and what. Results showed that athletes used imagery in two locations: competition and practice (*where*). Other research has found that athletes also use imagery while at home, when travelling,

³ A version of this study has been submitted to *International Journal of Sport Psychology* and is currently under review.

and when injured (Driediger, Hall, & Callow, 2006). In addition to the locations of athletes' imagery use, there are specific times when athletes are more likely to use imagery (*when*). Athletes use imagery most often before competition, compared to during or after competition (Munroe et al., 2000). Athletes are also more likely to use imagery during practice than before or after practice. Over a competitive season, Cumming and Hall (2002a) noted that athletes are more likely to use imagery during the latter parts of the season compared to the start of the season or during the off-season.

In addition to describing where and when athletes use imagery, Munroe and colleagues (2000) described a number of characteristics related to the content of athletes' images (*what*), as well as found specific reasons for *why* athletes use imagery. In terms of *what* athletes were imaging, Munroe and colleagues grouped these characteristics into six major categories. These characteristics described the sessions (i.e., duration and frequency), effectiveness, nature (i.e., accuracy, positive, and negative), surroundings, type (i.e., modalities such as visual, auditory, kinesthetic, etc.), and controllability. Overall, these characteristics of imagery use have provided a foundation for researchers to determine how athletes can optimize their imagery training and effectively improve their performance (e.g., image positive outcomes in order to enhance performance; Weinberg & Gould, 2003).

Athletes' reasons for using imagery (*why*) mostly supported the five functions of imagery use previously described by Hall and colleagues (1998). CG imagery was used to practice and execute various game plans or strategies. CS imagery was used by athletes to develop and correct their skills as well as enhance their overall performance. MG-A imagery was used by athletes to generate excitement, maintain control over a

situation, or to relax. MG-M imagery was used to enhance athletes' confidence, focus, mental toughness, or positivity. Finally, MS imagery was used to imagine process or outcome goals related to their performance or competitions. In addition to these five functions, Munroe and colleagues also found that athletes used motivational imagery to get into a state of flow, or automated performance.

Models of Imagery Use

Using the five functions of imagery use as a basis, Martin, Moritz, and Hall (1999) developed the applied model of imagery use, aimed at describing how athletes use imagery to affect a variety of sport-related outcomes. The applied model of imagery use consists of three sequential components: sport situation → imagery type → outcome. In addition, imagery ability was included as a moderator of the relationship between imagery use and outcomes because the extent to which an athlete can use imagery affects whether they will be able to experience successful outcomes (e.g., Robin et al., 2007). Martin and colleagues found that athletes typically use imagery in training, competition, and rehabilitation. Regardless of the situation in which imagery is being used, Martin and colleagues suggested that athletes should choose the type of imagery (i.e., one of the five imagery functions) that best matches their intended outcome (i.e., learning and improving skills and strategies, modifying cognitions, and regulating arousal and anxiety). For example, an athlete who wants to improve their execution of a game strategies should employ CG imagery.

Contrary to the applied model of imagery use suggesting, “what you see really is what you get” (Martin et al., 1999, p. 260), research has since found that a single image can effect multiple outcomes (e.g., Nordin & Cumming, 2008). Athletes can assign

different meanings to the same image (Short, Monsma, & Short, 2004). Callow and Hardy (2001) suggested that two athletes might use the same type of imagery to fulfill different functions. For example, one athlete may use CG imagery rehearse game strategies, fulfilling the CG function, while a second athlete may use CG imagery to psych themselves up to use a particular game strategy, fulfilling the MG-A function.

In order to incorporate these recent developments in imagery research since the creation of the original applied model, Cumming and Williams (2013) introduced the revised applied model of deliberate imagery use for sport, dance, exercise, and rehabilitation (Figure 9). To provide clarity in their model amongst the use of the terms ‘imagery type’ and ‘imagery function’ and allow for individual interpretation of the meaning of images, Cumming and Williams distinguished imagery type as referring to the content and characteristics of imagery use (*what*) and imagery function as referring to the reason imagery is being employed (*why*). In addition to making reference to the importance of what an image means to an athlete, the revised applied model of deliberate imagery use also suggests that characteristics of the athlete (*who*) will influence the imagery function. The purpose of the revised applied model of deliberate imagery use was to aid in the development of more effective imagery interventions by considering the

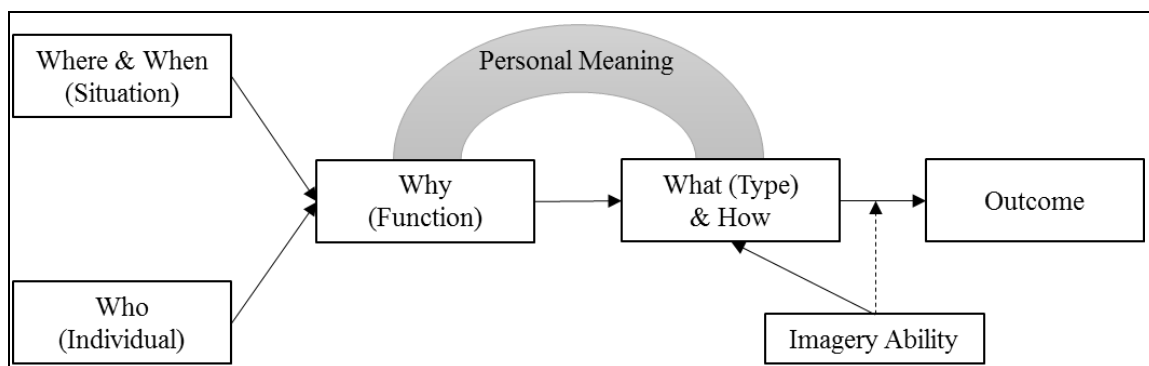


Figure 9 Revised applied model of deliberate imagery use
Adapted from Cumming & Williams (2013).

myriad of elements that interact to affect the outcomes of imagery use (Cumming & Williams, 2013). In addition, Cumming and Williams called for researchers to examine the interactions between the different elements of the model and how achieved outcomes are altered (e.g., the interaction between where and when [situation] and why [function]).

CG Imagery Research

Research examining the effects of various types of imagery on performance have generally focused on CS and MG-M imagery. Athletes who practiced CS imagery improved their performance on a soccer task (Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012). Badminton players increased their sport confidence following MG-M imagery training (Callow, Hardy, & Hall, 2001). It has been argued that the focus on certain imagery functions can cause researchers to miss other ways that imagery can improve athletic performance (Murphy, 1994). In response, there has been a call for additional research on imagery functions such as CG imagery (Martin et al., 1999).

Little is known about the effects of CG imagery use on performance. Case studies and anecdotal evidence suggest that CG imagery is used by athletes to practice and improve game strategies in a number of sports, including: artistic gymnastics (White & Hardy, 1998), canoe slalom races (MacIntyre & Moran, 1996; White & Hardy, 1998), climbers (Boyd & Munroe, 2003), football (Fenker & Lambiotte, 1987), golf (Paivio, 1985), pommel horse routines in gymnastics (Mace, Eastman, & Carroll, 1987), skiing (Rotella, Gansneder, Ojala, & Billing, 1980), and wrestling (Rushall, 1988). Two interventions that attempted to improve strategy performance using CG imagery training found mixed results. A six-week CG imagery training program increased the use of CG imagery by youth soccer players, but failed to show a significant effect on strategy

performance (Munroe-Chandler, Hall, Fishburne, & Shannon, 2005). Basketball players who mentally and physically practiced a basketball strategy performed better than basketball players who only practiced the strategy (Guillot, Nadrowska, & Collet, 2009).

Qualitative research allows researchers to gain a more in-depth understanding of how imagery is used effectively in sport. Despite the detailed information available regarding the general use of imagery in sport, research has not exclusively examined the use of CG imagery. However, three qualitative studies have reported meaningful findings regarding why athletes use CG imagery. Interviews with a rugby player who participated in a season-long imagery intervention indicated that CG imagery use increased compared to the start of the season (Evans Jones, & Mullen, 2004). In addition, the rugby player found CG images to be useful in enhancing his confidence and game preparation, as well as improving his overall performance. MacIntyre and Moran (2007) found that CG imagery was used most often by elite canoe slalomists. These findings extended research on why athletes use CG imagery as the canoe slalomists described using CG imagery to learn a course, for pre-competition routines, to review performances, to stimulate creativity in navigating a course, or to model other athletes' performances (MacIntyre & Moran, 2007). Field interviews conducted with professional golfers revealed that CG imagery was used to prepare strategic and tactical aspects of their play (Bernier & Fournier 2010). This included planning what strategies to employ in an upcoming round, choosing what shot to play, and choosing which golf club to use.

The Present Study

Study 2 and Study 3 in this dissertation showed promising results regarding the effectiveness of CG imagery training on improved tactical decision-making in curling.

However, quantitative research can be limited in its ability to fully explain a behaviour. Qualitative research, on the other hand, focuses on discovering a richer description of the entire process of a behaviour (Denzin & Lincoln, 2005). To date, only one qualitative study of imagery use by young athletes included curlers in the sample (Munroe-Chandler, Hall, Fishburne, & Strachan, 2007), however, the results were combined with athletes from 21 other sports. It is likely that CG imagery plays a major role in this context; however, little detail is known about when, why, and how it is used.

Considering that the revised applied model of deliberate imagery use highlights the importance of what particular images mean to an athlete (Cumming & Williams, 2013), it is possible that curlers may use CG imagery for functions and outcomes beyond traditional CG functions, such as improved tactical decision-making (e.g., MG-A function; Callow & Hardy, 2001). Furthermore, little information is known regarding how the various components of imagery use (i.e., where, when, why, what, and how) interact with each other in this context. Therefore, the purpose of the present study was to gain a greater understanding of how CG imagery is used in the unique sport context of curling. A social constructionist epistemology was followed in order to learn how athletes construct knowledge and meaning (of CG imagery use) based on social interactions within their environments (Crotty, 1998).

Method

Focus groups were used to collect the data in order to discover how CG imagery is used in curling. A focus group can be thought of as “a discussion involving a small group of participants, led by a moderator that seeks to gain an insight into the participants’ experiences, attitudes, or perceptions” (Hennessy & Heary, 2005, p.236).

Focus groups were chosen for this study because they provide a richer environment for the discovery of in-depth information about a given topic as participants are able to converse with each other (Krueger & Casey, 2009). Because CG imagery refers to images of game strategies and tactics (Hall et al., 1998), only curlers who have experience playing the skip position (i.e., the player who directs the strategy of the game) were recruited to participate in the focus groups. In order to gain a richer understanding of the use of CG imagery in curling, skips of varying competitive levels (i.e., competitive and recreational), age, and both genders were recruited. In total, three focus groups were conducted with four or five skips per group. Efforts were made to ensure homogeneity in age, gender, and curling experience in each group; however, groups were primarily assembled based on participants' availability.

Participants

The participants were five female curlers and nine male curlers ($M_{age} = 57.57$, $SD = 19.94$), who predominantly play the position of skip. The curlers played at both recreational ($n = 11$) and competitive levels ($n = 3$), and within the group there was a large range of years played, ranging from 7 to 61 years ($M = 30.86$, $SD = 16.53$). Participants also reported varying lengths of experience playing the skip position, ranging from 1 to 50 years ($M = 16.86$, $SD = 15.30$). Demographic information for each participant can be found in Table 6.

Procedure

Approval to conduct this study was granted by Western University's Research Ethics Board and written consent was obtained from all participants involved in the focus groups. Participants were recruited from local curling clubs in early spring, shortly after

Table 6
Demographic information of skips who participated in the focus groups

| Participant | Age | Gender | Years Curlled | Years Skipped | Competitive Level |
|-------------|-----|--------|------------------|---------------|----------------------|
| A | 69 | Female | 43 | 25 | Recreational |
| B | 54 | Male | 7 | 1 | Recreational |
| C | 71 | Male | 37 | 27 | Recreational |
| D | 53 | Male | 28 | 10 | Recreational |
| E | 63 | Male | 15 | 6 | Recreational |
| F | 32 | Female | 24 | 3 | Competitive |
| G | 77 | Male | 61 | 40 | Recreational |
| H | 50 | Male | 37 | 6 | Recreational |
| I | 70 | Male | 50 | 50 | Recreational |
| J | 85 | Male | 50 | 30 | Recreational |
| K | 71 | Female | 20 | 7 | Recreational |
| L | 67 | Male | 35 | 17 | Recreational |
| M | 22 | Female | 14 | 12 | Competitive |
| N | 22 | Female | 11 | 2 | Competitive |

the curling season ended. Each focus group consisted of two moderators; one moderator (a PhD student with a master's degree in sport psychology) ran the focus groups and a second moderator (a PhD candidate with a master's degree in sport psychology, three years of experience working as a mental performance consultant, and over 20 years of curling experience as an athlete and coach) oversaw the focus groups, took notes, and clarified any questions or responses as necessary. The focus groups lasted 40 to 65 minutes, depending on how much information was shared. A semi-structured interview guide was developed using guidelines put forth by Krueger and Casey (2009). At the start of each focus group, participants were asked to describe imagery and if they had heard the term before. Given the potential for a range of exposure to imagery among the participants, the following definition of imagery was used to ensure that participants had a similar understanding of imagery in the context of the present study:

Imagery is an experience that mimics real experience. We can be aware of

“seeing” an image, feeling movements as an image, or experiencing an image of

smell, tastes, or sounds without actually experiencing the real thing. Sometimes people find that it helps to close their eyes. It differs from dreams in that we are awake and conscious when we form an image. (White & Hardy, 1998, p. 389)

In addition, participants were informed that the focus group was centred around the use of imagery for game plans and strategies (CG imagery). The main questions were divided into four categories, based on Munroe and colleagues' (2000) four Ws of imagery use and the revised applied model of deliberate imagery use (Cumming & Williams, 2013), with the purpose of finding out *where*, *when*, *why*, and *how* skips use CG imagery. When necessary, probes were used to elicit more detail in the participants' responses (Patton, 2002). Participants were given a verbal summary of all their responses at the end of each focus group and were asked if they wanted to clarify any responses or add anything that had not been discussed (Krueger & Casey, 2009).

Data Analysis

All focus groups were audio-recorded and transcribed verbatim. Identifying information was removed to maintain confidentiality. Participants' names were replaced with letters to track their responses throughout the transcripts. The transcripts were coded using NVivo10 (QSR International, 2012). The constant comparative method (Strauss & Corbin, 1990) was used to form categories from similar concepts in the transcripts (i.e., words, phrases, or sentences). Throughout the analysis, both deductive and inductive analysis techniques were used (Patton, 2002). Deductive analysis was used to develop categories and themes among the data using prominent imagery literature, including the four Ws of imagery use (Munroe et al., 2000) and the revised applied model of deliberate imagery use (Cumming & Williams, 2013). Inductive analysis allowed new

categories and relationships to be discovered among the data. When interpreting the results, the findings were discussed to ensure that they were representative of the participants' responses (Taylor, Ntoumanis, & Smith, 2009). Reflexive self-awareness also was used to encourage alternative explanations to the findings (Sparkes & Smith, 2014) in order to mitigate any potential bias from the author's experiences as a competitive curler. Following a social constructionist epistemology, the goal of the data analysis was to represent the skips' use of CG imagery that have been developed based on their unique experiences with various teammates, coaches, and opponents, rather than search for the truth or correct interpretation of the data (Crotty, 1998).

Results

In total, 850 text units were coded into four main themes: Situations (i.e., where and when), Functions (i.e., why), Characteristics (i.e., how), and Imagery Ability with 18 categories and 48 sub-categories. The breakdown of the categories within each theme are as follows: (a) Situations: competition, practice, and spectating (Figure 10), (b) Functions: CG, MG-A, and MG-M (Figure 11), (c) Characteristics: agency, color, environment, modality, nature, perspective, sessions, and speed (Figure 12), and (d) Imagery Ability: accuracy, controllability, effectiveness, and vividness (Figure 13). Following suggestions by Cummings and Williams (2013), the main themes were further examined to determine how various aspects of imagery use interact with each other. To this end, the findings are discussed below in terms of interactions between the situation and function, function and characteristics, as well as imagery ability, and the interaction among skips, function, situation, and content. Table 7 shows the different ways that each of the participants described using CG imagery.

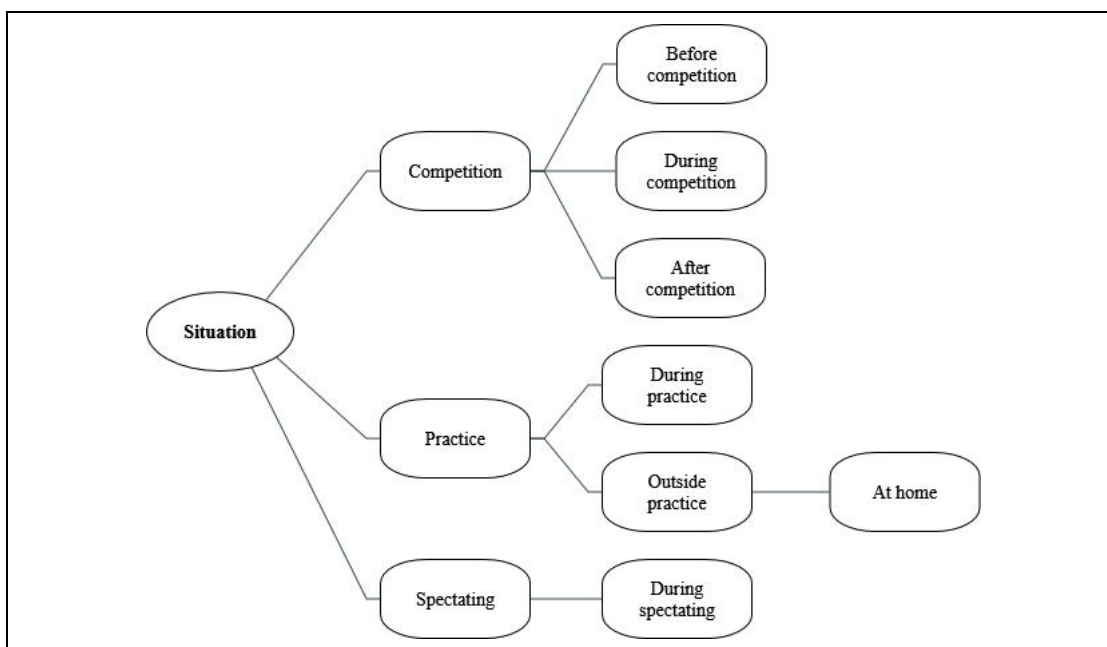


Figure 10 Situations (where and when) of cognitive general imagery use

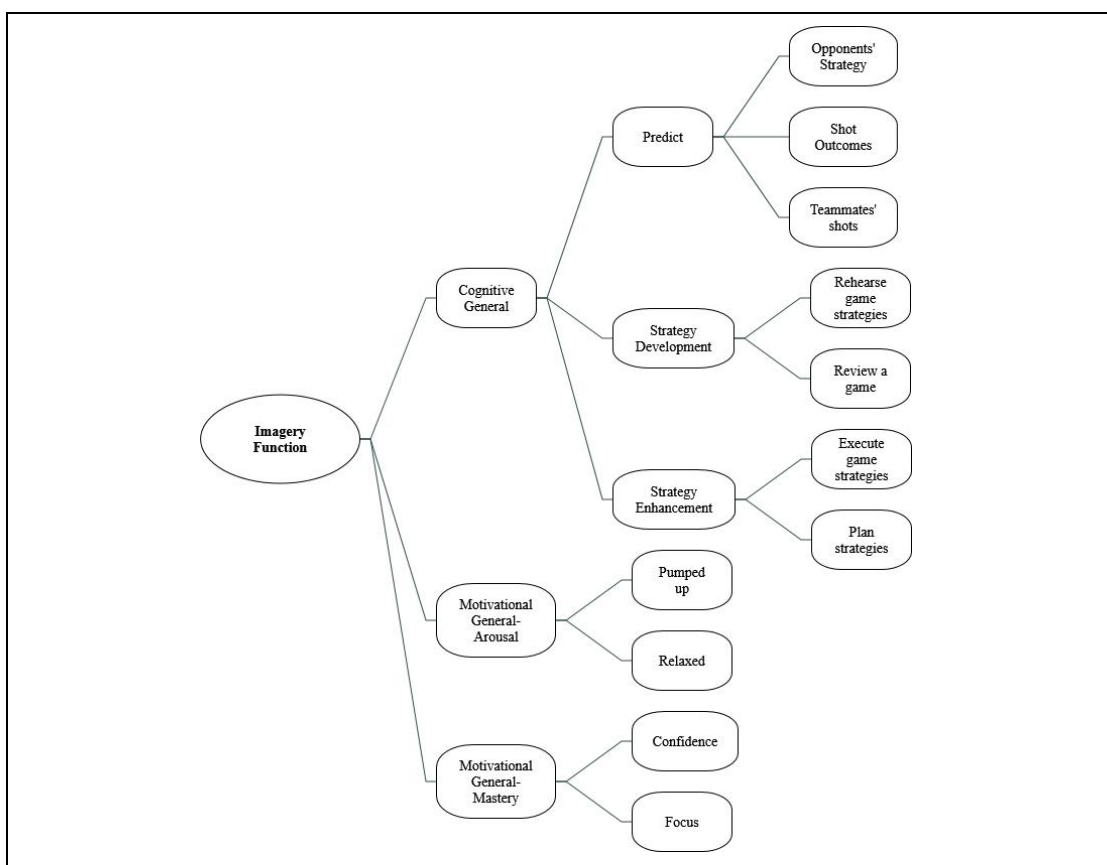


Figure 11 Functions (why) of cognitive general imagery use

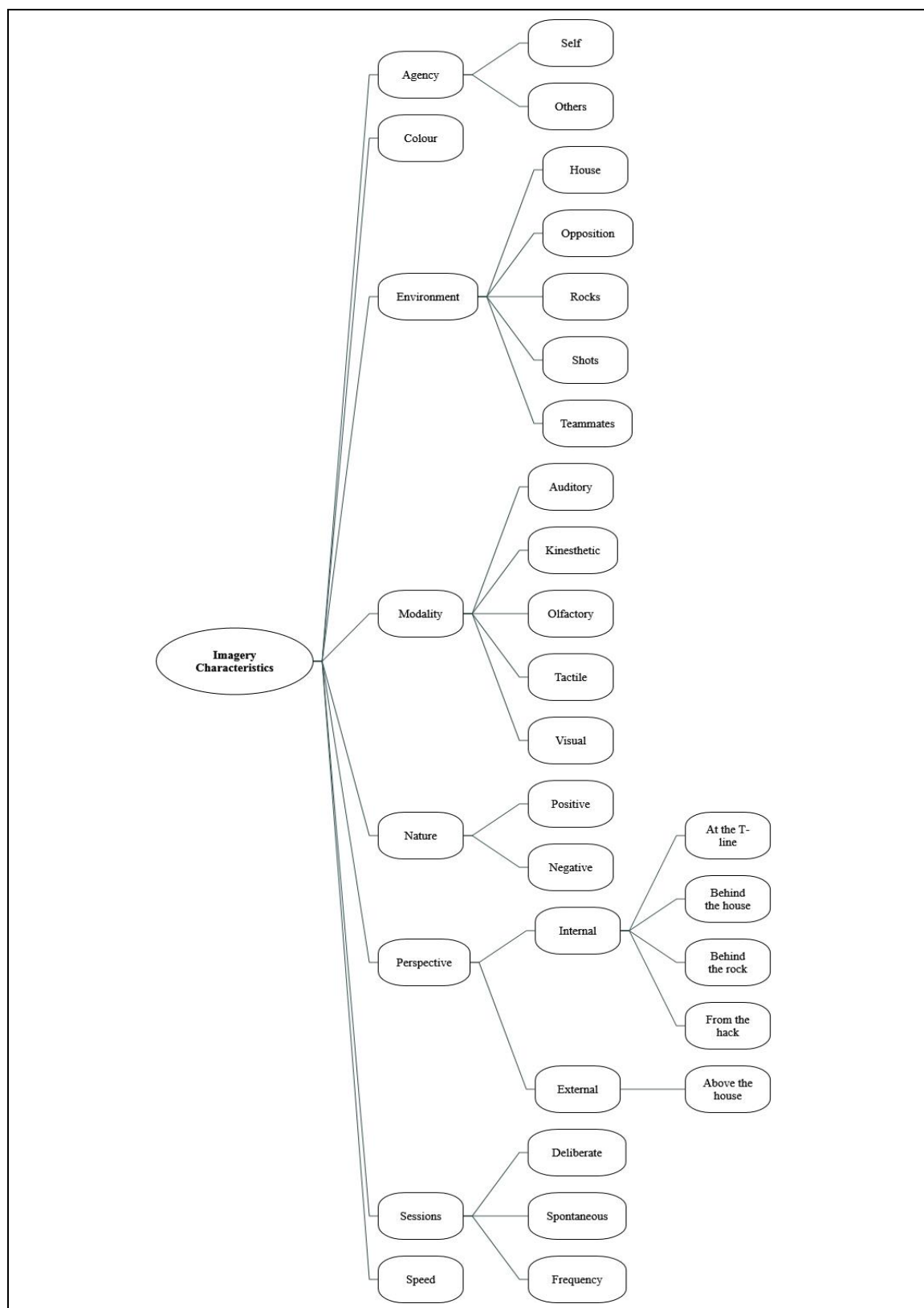


Figure 12 Characteristics (how) of cognitive general imagery use

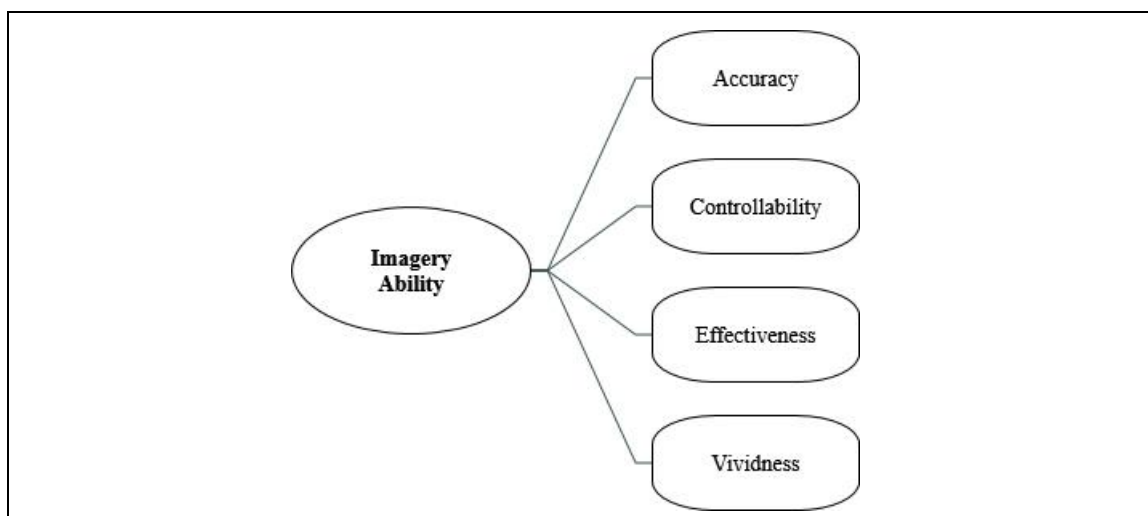


Figure 13 Characteristics of imagery ability

Table 7

The use of CG imagery in curling by skips

| Who | Where and When | Why | What | How |
|---|--------------------|---|------------------|--|
| Participant A: female, recreational | During competition | Execute game strategies, Predict opponents' strategies, Plan strategies, Predict teammates' shots | | Spontaneous, frequency, deliberate, negative, positive, vividness |
| | During practice | Plan and rehearse strategies | House | Spontaneous |
| | While spectating | Plan strategies, predict shots while spectating | | |
| Participant B: male, recreational | During competition | Confidence | | |
| | While spectating | Execute game strategies, plan strategies, review, predict shots while spectating | | Spontaneous, auditory |
| Participant C: male, recreational | Before competition | Plan strategies, Predict opponents' strategies | | Deliberate |
| | During competition | Execute game strategies, plan strategies, predict teammates' shots | Team-mates Shots | Internal (from the hack, behind the house, at the T-line), negative, effectiveness, visual |
| | While spectating | | | |

(continued)

Table 7 *cont.*

| Who | Where and When | Why | What | How |
|--|--------------------|---|------------|--|
| Participant D: male, recreational | During competition | Execute game strategies, plan strategies, predict opponents' strategies, predict teammates' shots, rehearse game strategies | Rocks | Visual, accuracy, effectiveness, frequency, deliberate, spontaneous |
| | While spectating | | | |
| Participant E: male, recreational | During competition | Execute game strategies, plan strategies, predict opponents' strategies, predict teammates' shots | | internal (behind the house), external (above the house), visual, real-time speed, deliberate, spontaneous, frequency |
| | While spectating | | | |
| Participant F: female, competitive | Before competition | Focus, pumped up, plan strategies, predict opponents' strategies | Opposition | Others, spontaneous, deliberate, frequency |
| | During competition | Focus, execute game strategies, plan strategies, predict opponents' strategies, predict teammates' shots | Shots | Visual, deliberate, spontaneous |
| | After competition | Relaxed, review a game | Rocks | Positive, negative, spontaneous |
| | While spectating | Plan strategies, predict shots while spectating | | Spontaneous |
| Participant G: male, recreational | Before competition | Plan strategies | | |
| | During competition | Confidence, execute game strategies, plan strategies, predict opponents' strategies | Rocks | Spontaneous |

Table 7 *cont.*

| Who | Where and When | Why | What | How |
|---|--------------------|---|-----------------------|----------------------------------|
| | While spectating | Predict shots while spectating | | Spontaneous |
| (continued) | | | | |
| Participant H: male, recreational | Before competition | Relaxed | | |
| | During competition | Execute game strategies, plan strategies, predict teammates' shots | | Visual, spontaneous |
| | After competition | Relaxed, review a game | | Deliberate |
| | While spectating | Predict shots while spectating | | |
| Participant I: male, recreational | Before competition | Plan strategies, predict opponents' strategies | | Deliberate |
| | During competition | Confidence, execute game strategies, plan strategies, predict teammates' shots | Shots | Spontaneous |
| | While spectating | Predict shots while spectating | | |
| Participant J: male, recreational | Before competition | Predict opponents' strategies, predict teammates' shots | Shots | Visual |
| | During competition | Execute game strategies, plan strategies, predict opponents' strategies, predict teammates' shots | Opposition, shots | Positive, spontaneous |
| | While spectating | Predict shots while spectating | | |
| Participant K: female, recreational | Before competition | Rehearse game strategies | | Positive, negative, deliberate |
| | During competition | Execute game strategies, plan strategies, predict teammates' shots, rehearse game strategies | Shots | Visual, negative, deliberate |
| | While spectating | Predict shots while spectating | | |
| Participant L: male, recreational | Before competition | Execute game strategies, predict opponents' strategies, plan strategies | Opposition, teammates | Visual, deliberate effectiveness |
| | During competition | Execute game strategies, plan strategies, predict teammates' shots | Teammate rocks | Positive, negative, deliberate |

Table 7 *cont.*

| Who | Where and When | Why | What | How |
|--|--------------------|---|---------------------------------|--|
| | While spectating | Predict shots while spectating | | (continued) |
| Participant M: female, competitive | Before competition | Plan strategies, review a game | | Spontaneous, frequency, effectiveness |
| | During competition | Execute game strategies, plan strategies, predict opponents' strategies | | |
| | After competition | Review a game | | Positive |
| | While spectating | Plan strategies, predict opponents' strategies, predict shots while spectating | Shots | Spontaneous |
| Participant N: female, competitive | Before competition | Plan strategies, predict opponents' strategies, review a game | House, rocks, opposition, shots | Visual, frequency, deliberate, spontaneous |
| | During competition | Execute game strategies, plan strategies, predict opponents' strategies, predict teammates' shots, rehearse game strategies | Shots | Frequency |
| | After competition | Execute game strategies, plan strategies, predict opponents' strategies, rehearse game strategies, review a game | | |

Interactions between Situation and Function

CG imagery. Curling is a strategic game. According to Participant D, “the images that we’re talking about, to do with strategy, are really important because it [curling] is such a chess game.” The skips’ use of CG imagery to fulfill the CG function varied according to the situation. Before competition, skips typically use CG imagery to plan their strategy for the upcoming game, which sometimes includes predicting what their opponent’s strategy might be:

I try to do it [use CG imagery] before the game. If I'm playing a team that, in league play and the team is at the bottom of the league, and I'm up near the top and I've got to play them, I'm thinking about that game and what I'm going to do with that team according to the shots that I'm going to have my people [teammates] make. (Participant C)

During competition, skips reported using the CG function to plan and execute a game strategy, predict their opponent's strategy, as well as watch their teammates execute their shots according to the strategy being used:

[When] imagining how the game is going to go, that image can change, not only from the beginning of the game to the end of the game, but from the first rock of the end to the last rock of the end because if your team doesn't throw where you anticipate they will, it changes exactly how you're going to play the end and it also depends on what the opposition is throwing as well. (Participant A)

After competition, skips use CG imagery to review a game or rehearse and plan strategies that could be used in a future game: "...remembering scenarios and replaying those scenarios in my head and saying, 'kay next time I get to this shot here, I'm going to peel,' or 'I'm going to play the tap,' instead of what I did do" (Participant M). Skips reported the benefit of using CG imagery during practice to rehearse or plan strategies to prepare for game situations:

Imagery would help in a practicing situation, where you know, you've imagined how the house is, what you were just saying, you've imagined how the house is set up. These are the shots that I can make, to make sure that I score or force them to one, once you've got a practice situation. So if you can imagine some

sort of scenario, where the house is sitting, the way it is, and then figure out how you're going to get in there and do what you need to do. (Participant A)

Finally, skips reported using the CG function to help improve their strategy performance while watching games on TV:

When I watch a game on TV sometimes [I ask myself], would I play this shot?

And they're talking about a shot and I'll try to say, 'okay, they should play this' in my head and go through the motions. I guess [that's a way of] giving myself practice in strategy in anticipating, 'okay, well I think that this is the right shot,' and seeing if that's the shot they [the curlers] end up playing and do our thoughts align. (Participant F)

MG-A imagery. The MG-A functions of being pumped up and relaxing were discussed by the skips. Participant F described using CG imagery before competition to pump herself up: "That's how you get into [it] ... and how you get yourself pumped up and zoned in". In contrast, Participant H uses CG imagery before and after competition to relax: "I tend to be a little more relaxed when I'm not in the game". Participant F also described using CG imagery to relax after competition: "you might be a little more relaxed in replaying some of the scenarios."

MG-M imagery. Confidence and focus were two MG-M functions that were discussed by the skips. During competition, CG imagery can help skips feel more confident. "If you can imagine what happens and you can learn from it, it gives you confidence that makes you feel better about the game" (Participant B). Participant F described using CG imagery to help improve her focus before competition: "You get yourself focused [before a game] and to sort of mentally prepare yourself for what's

going to happen.” During competition, Participant F also described the importance of staying focused: “It’s [CG imagery is] just what I need to do to keep focused and to make sure that I’m learning everything about the ice and the other teams to be able to predict what I think they’re [opponents] gonna [sic] do.”

Interaction among Function and Characteristics

The characteristics of skips’ CG imagery use also varied according to the function. In terms of executing different games strategies, skips incorporate different aspects of the environment into their images. For example, skips might only visualize the rocks in the house when trying to decide what strategy to execute:

The images that we’re talking about, to do with strategy, I think are really important because it is such a chess game ... if we do this, then that rock will roll there, then we’ll come around that one. And mentally, I’m seeing it. I can see where those rocks are, so by the time I talk about the fourth shot [of an end], you can visualize what the rocks look like. (Participant D)

Participant N, on the other hand, described visualizing an entire shot when trying to figure out where to have her players aim in order to execute a strategy:

I feel like I visualize most when I’m giving ice [calling a shot] because I think about how the rock is going to be coming down the sheet in that specific spot, before putting the broom down, and it helps me determine where to put it. So I’m visualizing if it’s [the rock] going to break late, or break early, or not curl at all.

When reviewing a game, skips’ images could sometimes be negative to help them learn from tactical mistakes that occurred during a game:

I wouldn't say I play out every shot, but the key momentum ends with momentum swings are usually the ones that we [curling team] talk about or I try to replay in my head and say, 'okay, where did this go wrong?' (Participant F)

Positive images are important when skips visualize various strategy outcomes to pump themselves up: "You feel charged up. Cause [sic] you're imaging the positive, ... happening so you are going, 'this is going to happen'" (Participant I).

Skips used both internal and external perspectives when using CG imagery. An external view of the playing area from above the house was used when watching a curling game on television:

You watch the TV shots and then you imagine yourself saying, 'I wanna [sic] do a shot like that.' As the rock comes into the house, I can't really tell, accurately, how fast it's going and where exactly it'll end up. ... The only way I can imagine where it's going to end up is to think about that overhead camera shot and say, 'Oh! It's gotta go another two feet, and doesn't look like it will.'" (Participant B)

From the internal perspective, a number of different angles were used when viewing the playing area. Sometimes, this allows skips to gain a more comprehensive understanding of how to plan and execute their strategy, as well as helping to determine the best shot to call in a situation. As illustrated by Participant A, "There have been times when I've called a shot while standing in the house and then get down to the hack and you say, 'there's no way that that's going to happen,' but you see an alternative as well."

Imagery Ability

In the revised applied model of deliberate imagery use, imagery ability is proposed to mediate the content and characteristics of imagery use (i.e., what and how),

as well as moderate the relationship between what is imaged and the associated outcomes (Cumming & Williams, 2013). For this reason, imagery ability was considered independently. Four categories emerged in regards to skips' abilities to use CG imagery: accuracy of the images, vividness, controllability, and effectiveness. Skips indicated making sure that their images accurately reflected the environments where they play:

If we go to bonspiel and the [rock] handles are black and red, or different colours, I just visualize what the colors of the stones are in that. And then, you go to another place and at home [curling club], it'll be blue and red. (Participant C)

To that end, Participant N described her imagery as being extremely vivid:

I definitely have a really immersive experience when I'm visualizing. I see everything. ... [When I'm visualizing] previous games I've had against my opponents, it's also in the club we played them. I can also recall the colors of the rings [houses] for that club.

In terms of the controllability of the images, Participant I noted that using CG imagery was easy because "you're in control." Participant H followed up this statement by saying, "It [using CG imagery] is easy in my head" (Participant H). Finally, skips found that visualizing how they would like their game strategies to play out was generally effective and helped them be successful. In addition, it can help skips feel prepared and more confident going into a game:

I find the more you have visualized, or the more you have planned before going on the ice, the more you know. The more you know, the less surprises, the more comfortable you are. ... It's just increasing your comfort and confidence going on the ice. If you know a lot about the ice already, ... you know that first end,

you're putting [the rock] up top four [foot] and you're going to blank that first end so that you can take two [points] in two [the second end]. (Participant M)

Interactions among Skips and Function, Situation, and Content

A few differences emerged in regards to individual characteristics of skips and their CG imagery use, especially when considering the use of CG imagery to serve motivational functions. The function of confidence was only brought up by male non-competitive skips. Interestingly, two of these skips had curled the longest, while the third had the least amount of experience curling and had only been skipping for one season. In addition, the function of focus was only discussed by a female competitive curler (Participant F). Although she had curled for most of her life, she was new to the position of skip, and thus used CG imagery to help her focus on her new role both before and during competition. Furthermore, Participant F reported using CG imagery for the greatest number of motivational functions (i.e., focus, pumped up, and relax) compared to the other skips who participated.

Discussion

The purpose of the present study was to extend previous research on the use of CG imagery in sport by examining its use in curling employing a qualitative methodology. Specifically, skips' use of CG imagery in curling was investigated by employing the four Ws of imagery use (Munroe et al., 2000) and the revised applied model of deliberate imagery use (Cumming & Williams, 2013) as guiding frameworks. A combination of deductive and inductive analyses determined that skips' CG imagery use could be categorized according to the situation, function, and characteristics in which it is used. The findings support the revised applied model of deliberate imagery use in

that the characteristics of each skip's CG imagery use differs according to what they find personally meaningful and most effective in helping them achieve their desired performance outcomes (Cumming & Williams, 2013).

In terms of the situation in which CG imagery is used (i.e., where and when), the findings supported previous research in sport, finding that CG imagery is employed before, during, and after competition, during practice, and at home (Driediger et al., 2006; Munroe, Hall, Simms, & Weinberg, 1998). A new finding that emerged from the data was the use of CG imagery while spectating, which could occur when skips watch curling games on television. This finding may be unique to the highly strategic nature of the sport, and the rise of televised curling games allows skips to develop their own strategies for use in future curling games, as well as make use of external cues to help visualize various aspects of performance (Cumming & Williams, 2012).

Skips use CG imagery to fulfill a variety of strategy-related (CG) functions (i.e., why) and tend to use certain ones, depending on the situation (Munroe et al., 2000; Munroe-Chandler et al., 2007). Before competition, skips spend their time preparing a game plan for their upcoming opponents and predicting how they might approach the game, similar to how a golfer might prepare for an upcoming round (e.g., Bernier & Fournier, 2010). During competition, skips tend to spend time using CG imagery to plan and execute game strategies (Munroe et al., 2000). In addition, skips reported using CG imagery for predicting opponents' strategies and predicting teammates' shot outcomes in order to help them make strategy decisions during the game. Previous research has supported the notion of using CG imagery to predict what is going to happen next (Munroe-Chandler et al., 2007), albeit not as detailed regarding the combination of these

different aspects in order to develop an ongoing game plan. Curling is a unique sport in this way as the implementation of the game strategy depends on a number of factors, including ice conditions, teammates' abilities, and opponents' strategy and shot execution (Canadian Curling Association, 2010). After competition, skips use CG imagery to review strategies that were implemented during previous games to determine their effectiveness. Skips may then modify these strategies if necessary and consolidate them into a future game plan (Bernier & Fournier, 2010).

In addition to using CG imagery to support strategy-based functions (i.e., CG), skips also use CG imagery to fulfill motivational functions (i.e., MG-A and MG-M). Despite the original notion that imagery content should match the intended function (Martin et al., 1999), the revised applied model of deliberate imagery use describes how the personal meaning of an image interacts can affect the function it serves (Cumming & Williams, 2013). In other words, athletes may utilize the same type of imagery (e.g., strategy-related images [CG]) to fulfill different functions (Nordin & Cumming, 2008). In the present sample, CG imagery was useful in certain situations to help moderate arousal levels or keep skips focused and feeling confident when directing the strategy for a game. Research in other sports have found that CG imagery can fulfill a number of motivational functions, including improving athletes' self-efficacy and self-confidence, helping them stay focused, and psyching themselves up to use a particular strategy (Callow & Hardy, 2001; Evans et al., 2004; Nordin & Cumming, 2008).

The characteristics (i.e., how) of skips' CG imagery use varied according to the function used. Varying amounts of detail were included in their imagery when skips were planning or executing a given strategy (i.e., fulfilling the CG function). Similarly,

golfers report using imagery to collect information about a given shot they are about to play in order to help the strategic preparation of that shot (Bernier & Fournier, 2010). In addition, skips adapted the content of their imagery to help regulate their arousal levels, similar to how golfers have learned to focus their attention or vary the activation of their images (Bernier & Fournier, 2010). A relatively novel finding relates to the number of different perspectives used by skips to help learn and plan different strategies. Although athletes have reported using a variety of viewing angles to see themselves executing a variety of physical movements (e.g., Callow & Roberts, 2010), it has not been reported in regards to tactical decision-making. This is a finding that may warrant further investigation considering that curlers in the present study found employing a number of perspectives useful in improving their understanding of the various shot options available to them in a given situation.

Finally, four features related to the skips' abilities to use CG imagery emerged: accuracy, controllability, effectiveness, and vividness. It is important that athletes learn to incorporate these features into their images in order to enhance the overall richness of their imagery sessions (Munroe et al., 2000). Furthermore, it is important to consider an athlete's level of imagery ability before beginning an imagery intervention considering the mediating and moderating effects of imagery ability on imagery content, and the effectiveness of imagery to effect desired outcomes (Cumming & Williams, 2013).

Overall, the present study identified a number of characteristics related to the use of CG imagery that is unique within the context of curling (e.g., the use of CG imagery while spectating or viewing the playing area from different angles using an internal perspective). In addition, the findings support the use of CG imagery by skips to serve

multiple functions, including and beyond the traditional strategy-based functions. Thus, there are a number of strengths to pull from the findings. First, the examination of a highly strategic sport that has not received much research attention provides new insight into how CG imagery can be beneficial for these athletes. Second, the present findings build on previous literature by identifying a new avenue in which athletes across competitive levels use CG imagery to refine their strategy abilities (e.g., predicting strategy calls while watching curling live or on television). Finally, the findings provide further support for the use of imagery to serve multiple functions. Although CG imagery is traditionally employed for strategy development, enhancement, and prediction (Munroe-Chandler et al., 2007), the results support its use to serve motivational functions (Nordin & Cumming, 2008). CG imagery use seems to have important implications for arousal regulation and the maintenance of both confidence and focus in competition.

Despite its strengths, there are some limitations to note. The sample consisted mostly of older male, recreational-level skips. Thus, caution must be taken into account when comparing the findings to other samples, as there might be differences in how CG imagery is used (e.g., used more often in practice for competitive samples; Munroe et al., 2000). Although a strength, the sport of focus can also be a limitation. Curling's unique characteristics as a closed-skill team sport makes it difficult to compare to open-skilled sports, such as soccer, or even closed-skill individual sports, such as golf, because the requirements for strategy are manifested quite differently across various sport types (Carron & Chelladurai, 1981). Finally, it may be considered inappropriate to compare the findings to a strictly competitive, adult sample (Munroe et al., 2000) and a youth sample (e.g., Munroe-Chandler et al., 2007). However, the use of both deductive and

inductive analyses helped mitigate this issue, allowing new findings to be identified (e.g., the use of CG imagery for strategy prediction while spectating), and realizing others that did not exist in the present sample (e.g., controllability of the images).

Taken together, these findings provide important implications for researchers and sport psychology consultants, especially those working in the sport of curling. First, it is important to determine both an athlete's specific performance needs, as well as determine how to best utilize mental skills, such as CG imagery, to serve those needs. For competitive curlers, a more thorough examination of their current CG imagery use may be necessary to help determine whether certain images are beneficial in helping them achieve their performance goals (i.e., serving cognitive or motivational functions) before interventions are developed. For recreational curlers, sport psychology consultants should introduce curlers not only to the different kinds of imagery that can be used, but also teach them that each one can be useful for different functions to help improve their performance. Individualized imagery interventions could then be created based on curlers' needs and preferences to help determine how imagery can best work to help them achieve their goals.

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General Summary, Strengths, and Implications

The overall purpose of this dissertation was to determine the effects of cognitive general (CG) imagery use on tactical decision-making in curling. To achieve this objective, multiple studies were conducted and described throughout the four studies comprising this dissertation. The purpose of Study 1 was to develop a measurement tool to assess tactical decision-making in curling (i.e., response accuracy and speed). The Curling Strategy Assessment Tool (CSAT-2) was developed in two phases. The purpose of Phase 1 was to assess 75 curling scenarios in order to determine the most correct answer for each situation using curlers who primarily played the positions of skip or vice. The results showed that 21 out of the 75 scenarios exhibited acceptable interrater agreement (70% or greater) for a correct answer. Preliminary testing of the CSAT with varsity curlers suggested that modifications were needed to the items in order to make them more reflective of the tactical decisions actually made in curling games (i.e., incorporating defensive, offensive, or blended strategy styles). Thus, the purpose of Phase 2 was to assess updated scenarios to determine the most correct answer for each situation using expert coaches. In total, 104 scenarios were evaluated. These updated scenarios were used to train and assess tactical decision-making in non-elite curlers. The development of the CSAT-2 provides researchers with a tool to measure tactical decision-making in curling, which can facilitate future CG imagery interventions.

Study 2 examined whether a six-week CG imagery intervention could improve the tactical decision-making abilities of varsity curlers, as measured by the CSAT. Curlers' response times (i.e. decision speed), but not response accuracy, significantly improved from baseline to post-intervention. A secondary purpose was to determine

whether the curlers' imagery abilities and imagery use would increase from baseline to post-intervention. Results revealed that curlers' kinesthetic imagery ability, CG imagery use, and MG-M imagery use significantly increased. It appears that because the curlers exhibited accurate responses at the start of the intervention, they focused their efforts on improving their response times following the CG imagery training. Furthermore, increases in both CG and MG-M imagery use provide additional support for the use of CG imagery to fulfill multiple imagery functions (i.e., both cognitive and motivational).

Study 3 examined the effects of an eight-week CG imagery intervention on the tactical decision-making abilities (measured by the CSAT-2) of three non-elite curlers using a single-subject multiple-baseline design. Visual and statistical analyses of the strategy performance data indicated that one curler improved her response accuracy and the other two curlers improved their response speed as a result of the CG imagery intervention. Social validation data collected following the completion of the study provided further support for the improvements in strategy decision-making. Overall, this study provides preliminary support for the use of CG imagery to improve tactical decision-making in curling and the use of the CSAT-2 to assess tactical decision-making.

The purpose of Study 4 was to better understand how CG imagery is used in the unique sport context of curling. Focus groups were conducted to determine where, when, why, and how skips use CG imagery. Deductive and inductive analyses revealed that skips use CG imagery to fulfill both cognitive (i.e., CG) and motivational functions (i.e., motivational general-arousal [MG-A] and motivational general-mastery [MG-M]), depending on the situation. Before competition, skips plan and prepare a game plan for use in an upcoming game. During competition, skips plan and execute game strategies,

and some skips reported using CG imagery to help boost their confidence. CG imagery is used after competition to review game strategies. During practice, skips reported using imagery to rehearse and plan game strategies. Finally, curlers reported using CG imagery while spectating to practice and predict strategy execution to help their own game plans. Overall, these findings provide insight into the various ways that skips use CG imagery in curling, which can help inform future research and imagery interventions.

Strengths of the Present Research

The findings of this research help to fill some of the gaps previously identified in the CG imagery literature (Martin et al., 1999; Westlund, Pope, & Tobin, 2012). Little information was known regarding the various outcomes associated with CG imagery use. One reason for the dearth of CG interventions in the sport psychology literature is due to the lack of reliable and valid measures of strategy performance (Westlund et al., 2012). The development of the CSAT-2 in Study 1 helps to fill gap by creating a reliable and valid measurement tool that assesses two aspects of curlers' strategy performance: response accuracy and response speed of tactical decision-making. It is important to measure both these aspects of tactical decision-making because not only do curlers need to make appropriate strategy decisions to improve their chances of winning a game, but they also must make these decisions in a timely manner. During competitive games lasting 10 ends, curlers are restricted to 38 minutes of thinking time to make strategy decisions (Canadian Curling Association, 2014b). The penalty for running out of thinking time is forfeiting the ability to throw any remaining rocks, which could result in losing the game. Thus, curlers must train both their decision-making accuracy and decision-making speed in order to improve their chances of being successful in games.

Using the CSAT and CSAT-2 as outcome measures, Study 2 and Study 3 further extend the imagery literature by supporting the effectiveness of CG imagery use for improving tactical decision-making in curling through applied interventions. Each intervention included curlers from two different competitive levels, which helped to discriminate performance improvements in higher and lesser skilled curlers. While both accuracy and speed are important in successful performance, a trade-off often exists between accuracy and speed, forcing athletes to focus on one at the expense of the other (Fitts, 1954). Following this idea, research has shown that lesser skilled athletes perform better when focusing their attention on accuracy, often at the expense of speed (Beilock, Bertenthal, Hoerger, & Carr, 2008). In contrast, higher skilled athletes are able to perform with both accuracy and speed (e.g., Beilock et al., 2008; Gabbett & Benton, 2009). As athletes gain practice with a skill, their behaviour becomes automatic and the speed-accuracy trade-off no longer applies (MacKay, 1982). Athletes can perform quickly without errors, as they no longer need to be conscious of what they are doing.

The findings from Study 4 support the use of CG imagery to fulfill a number of functions beyond the traditional strategy-related functions (Nordin & Cumming, 2008). It is now known that curlers use CG imagery to boost their confidence, help them focus, pump themselves up, and relax before, during, and after competition. In addition, the examination of a sport not often included in the literature has provided new insights into the use of CG imagery in a new context; the use of spectating to help develop, enhance, and predict game strategies in curling. The use of CG imagery while watching games live at events or on television can be applied in other sports to help athletes learn and transfer their knowledge of strategies in their own games and competitions.

To summarize, this dissertation provides preliminary support for the use of the CSAT-2 to assess tactical decision-making in curling, as well as the use of CG imagery training to improve tactical decision-making in both varsity and non-elite curlers. In addition, this dissertation entails a number of other strengths in making its contributions to the sport psychology literature. First, the research was carried out using both quantitative and qualitative methodologies. The inclusion of both methodologies allowed for broader conclusions to be made regarding the use of CG imagery in curling. Second, the two intervention studies entailed two different designs, both of which found some support for the positive effects of CG imagery use on tactical decision-making abilities. While the case study design employed in Study 2 provided initial support for the effectiveness of CG imagery on tactical decision-making abilities, Study 3 was the first intervention to employ a single-subject multiple-baseline design focusing solely on CG imagery use. Finally, the development of the CSAT-2 to measure tactical decision-making in curling helps to fill a gap in the CG imagery literature. The difficulties with measuring strategy performance has affected the ability to draw conclusions from CG interventions (e.g., Munroe-Chandler, Hall, Fishburne, & Shannon, 2005) and has been a potential hindrance on the number of CG interventions that have been conducted to date (Westlund et al., 2012).

Practical Implications and Future Research

Sport psychology consultants should encourage curlers to incorporate CG imagery use into their pre-game routine in order to help them plan and prepare for different game situations they might encounter against their upcoming opponent (e.g., Munroe, Giacobbi, Hall, & Weinberg, 2000). Using CG imagery during this time could

also help curlers feel more confident or focused going into a game if they know they are prepared to execute a certain game plan (e.g., Evans, Jones, & Mullen, 2004). CG imagery use can also be incorporated into curlers' post-game routines, helping them review and learn from the effectiveness or lack of effectiveness of employing various game strategies (Munroe et al., 2000). Moreover, CG imagery use could also be very beneficial during the off-season, when curlers do not have access to ice. This way, curlers could improve and maintain their tactical decision-making abilities by practicing their recall of various game situations and transferring their knowledge to new situations. Curlers could further improve their strategy performance by focusing first on making accurate decisions, and once accuracy is mastered, making quicker strategy decisions.

While the CSAT-2 allows for the measurement of tactical decision-making in curling, researchers should explore other avenues for its application. For example, researchers could use the CSAT-2 as a teaching tool to help train and test tactical decision-making in curlers who are new to the sport and unfamiliar with its strategy. In addition, different versions of the CSAT-2 could be developed to incorporate the varying types of strategies and shots encountered across levels of competition (e.g., bantam curling [under-16] versus men's curling [22 and older]) and other versions of the game (e.g., wheelchair curling). For example, all shots are delivered from a seated position and there is no sweeping in wheelchair curling. Thus, the types of shots that are played, as well as the overall strategy differs from able-bodied curling (Canadian Curling Association, 2014a). Thus, curlers who transition from able-bodied curling to wheelchair curling may need extra practice to learn and master the different game strategies.

Although the findings of this dissertation could be applied to sports with similar strategy decision-making processes (e.g., billiards or golf; Mann, Williams, Ward, & Janelle, 2007), researchers are encouraged to develop sport-specific measures of strategy performance in the sport(s) being targeted. Research in sport expertise supports the notion that expert athletes have superior cognitive and perceptual decision-making skills that are specific to their sport, and that there is little difference between experts and novices in general cognitive and perceptual decision-making abilities (e.g., Starkes, 1987). Developing a sport-specific measure of strategy performance can help athletes improve their sport-specific cognitive and perceptual abilities to make both accurate and quick strategy decisions (Abernathy, Neal, & Koning, 1994).

In conclusion, this dissertation has helped to progress the sport psychology literature by providing new insights into the use of CG imagery in a specific sport context. In addition, the initial development of a sport-specific measure of tactical decision-making has helped to provide evidence of the positive effects of CG imagery use on strategy performance. It is hoped that the findings of this dissertation encourages other researchers to develop sport-specific measures of strategy performance and use them to examine the effectiveness of CG imagery in other sports, providing athletes with another avenue to help improve their performance.

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Appendices

APPENDIX A

Curling Demographic Questionnaire (Study 1: Phase 1)

Please fill in the blank or check the appropriate answer:

1. Age: _____
2. Gender: _____ Male _____ Female
3. How many years have you curled? _____
4. Please select the level at which you are currently competing in curling:
 - _____ Recreational (e.g., do not practice/play curling *regularly*)
 - _____ Club Curler (e.g., play in a club league *regularly*)
 - _____ Competitive (e.g., play in competitive events/practice *regularly*)

IF YOU INDICATED THAT YOU ARE A COMPETITIVE CURLER (If you *are not* a competitive curler, skip ahead to question 5):

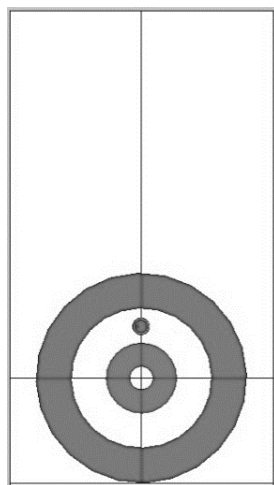
Please select the highest level at which you have competed in curling:

- _____ Zones
 - _____ Regionals
 - _____ Provincials (i.e., OUAs, OCAAs, OFSAA)
 - _____ Nationals (i.e., CIS, Junior National Championships)
 - _____ International (i.e., World Championships)
5. What position on the team do you usually play? _____
 6. How many years have you played this position? _____
 7. Is there a second position you have played fairly often? _____
 8. How many years have you played this position? _____

APPENDIX B

Sample Scenarios from the CSAT (Study 1: Phase 1)

Scenario 1



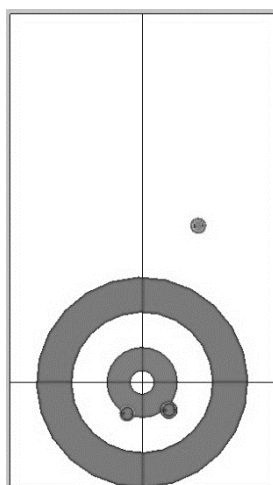
Score: 0-0

1st end, without last rock. Lead's 2nd rock. Your team is throwing yellow rocks.

What is the best shot option for this scenario?

- ☐ Centre guard
- ☐ Takeout
- ☐ Freeze
- ☐ Draw
- ☐ Other (please specify): _____

Scenario 32



Score: 5-5

8th end, without last rock. Skip's 2nd rock. Your team is throwing yellow rocks.

What is the best shot option for this scenario?

- ☐ Freeze on one of opponent's rocks
- ☐ Draw to button
- ☐ Counter clockwise hit and roll to sit on opponent's other rock (on left)
- ☐ Draw to top 4-foot
- ☐ Other (please specify): _____

APPENDIX C

Demographic Questionnaire for Coaches (Study 1: Phase 2)

Please fill in the blank or check the appropriate answer. Some questions may be left blank if they do not apply to you.

1. Age: _____
2. Gender:
_____ Male
_____ Female
_____ Prefer not to disclose
3. How many years have you been coaching curling? _____
4. What level of coaching certification to you currently hold? _____
5. What is the level/gender of the curling team you currently coach? _____
6. Please select the highest level at which you have coached in curling:
_____ Zones
_____ Regionals
_____ Provincials (i.e., OWG, OUAs, OCAAs, OFSAA)
_____ Nationals (i.e., CIS, Junior National Championships, Brier, Scotties)
_____ International (i.e., World Championships)

APPENDIX D

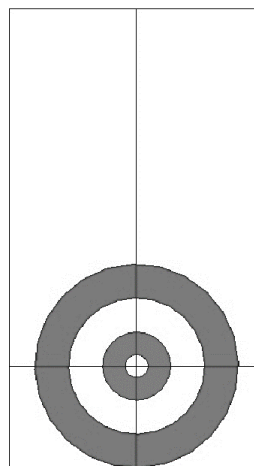
Sample Scenarios from the CSAT-2 (Study 1: Phase 2)

Scenario 1

Score: 0-0. 1st end without last rock (10 ends). Lead's 1st rock. Your team is throwing yellow rocks.

What is the defensive strategy call?

- ☐ Draw to the side of the house
- ☐ High centre guard
- ☐ Tight centre guard
- ☐ Draw to top 4-foot

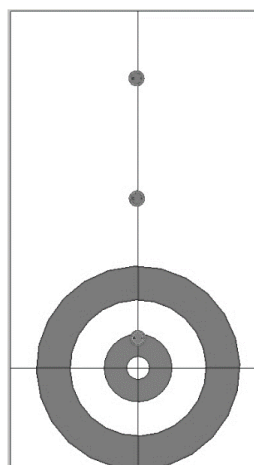


Scenario 52

Score: 5-4 (up 1). 9th end with last rock (10 ends). Lead's 2nd rock. Your team is throwing yellow rocks.

What is the offensive strategy call?

- ☐ Draw to the side of the house
- ☐ Tick shot on top guard
- ☐ Draw around guards to top 8-foot
- ☐ Corner guard



APPENDIX E

Curling Demographic Questionnaire (Study 2)

Please fill in the blank or check the appropriate answer:

1. Age: _____
2. Gender: _____ Male _____ Female
3. How many years have you curled? _____
4. Please select the level at which you are currently competing in curling:
 - _____ Recreational (e.g., do not practice/play curling *regularly*)
 - _____ Club Curler (e.g., play in a club league *regularly*)
 - _____ Competitive (e.g., play in competitive events/practice *regularly*)

IF YOU INDICATED THAT YOU ARE A COMPETITIVE CURLER (If you *are not* a competitive curler, skip ahead to question 5):

Please select the highest level at which you have competed in curling:

- _____ Zones
 - _____ Regionals
 - _____ Provincials (i.e., OUAs, OCAAs, OFSAA)
 - _____ Nationals (i.e., CIS, Junior National Championships)
 - _____ International (i.e., World Championships)
5. What position on the team do you usually play? _____
 6. How many years have you played this position? _____
 7. Is there a second position you have played fairly often? _____
 8. How many years have you played this position? _____

APPENDIX F

Movement Imagery Questionnaire-Revised (Study 2 and Study 3)

This questionnaire concerns two ways of *mentally* performing movements which are used by some people more than by others, and are more applicable to some types of movements than others. The first is attempting to form a visual image or picture of a movement in your mind. The second is attempting to feel what performing a movement is like without actually doing the movement. You are requested to do both of these mental tasks for a variety of movements in this questionnaire, and then rate how easy/difficult you found the tasks to be. The ratings that you give are not designed to assess the goodness or badness of the way you perform these mental tasks. They are attempts to discover the capacity individuals show for performing these tasks for different movements. There are no right or wrong ratings or some ratings that are better than others.

Each of the following statements describes a particular action or movement. Read each statement carefully and then actually perform the movements as described. Only perform the movement a single time. Return to the starting position for the movement just as if you were going to perform the action a second time. Then depending on which of the following you are asked to do, either (1) form as clear and vivid a visual image as possible of the movement just performed, or (2) attempt to feel yourself making the movement just performed without actually doing it.

After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task. Take your rating from the following scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movements “seen” or “felt” and it is not necessary to utilize the entire length of the scale.

RATING SCALES

Visual Imagery Scale

| | | | | | | |
|---------------------|----------------|-------------------------|-----------------------------------|-------------------------|----------------|---------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Very easy to see | Easy to see | Somewhat easy to see | Neutral (not easy nor hard) | Somewhat hard to see | Hard to see | Very hard to see |

Kinesthetic Imagery Scale

| | | | | | | |
|-------------------------|-----------------|--------------------------|-----------------------------------|--------------------------|-----------------|----------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Very easy to feel | Easy to feel | Somewhat easy to feel | Neutral (not easy nor hard) | Somewhat hard to feel | Hard to feel | Very hard to feel |

1. Starting Position: Stand with your feet and legs together and your arms at your sides.
 Action: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.
 Mental Task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

2. Starting Position: Stand with your feet slightly apart and your hands at your sides.
 Action: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
 Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

3. Starting Position: Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
 Action: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
 Mental Task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

4. Starting Position: Stand with your feet slightly apart and your arms fully extended above your head.
 Action: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.
 Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

5. Starting Position: Stand with your feet slightly apart and your hands at your sides.
 Action: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.
 Mental Task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

6. Starting Position: Stand with your feet and legs together and your arms at your sides.
 Action: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.
 Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

7. Starting Position: Stand with your feet slightly apart and your arms fully extended above your head.
 Action: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.
 Mental Task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

8. Starting Position: Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.
 Action: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.
 Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you are able to do this mental task.

RATING: _____

APPENDIX G

Sport Imagery Questionnaire (Study 2 and Study 3)

Please fill in the blank or check the appropriate answer:

Athletes use mental imagery in training and competition. Imagery serves two functions. The motivational function of imagery can represent emotion-arousing situations as well as specific goals and goal-oriented behaviors. The cognitive function entails the mental rehearsal of skills and strategies of play. A strategy is a plan or method of achieving some goal. In sport, this often is referred to as a game plan. For example, playing a *pressure game* to create turnovers is a possible strategy to use in basketball, and this could be done executing various skills and tactics (i.e., skills put together in a sequence), such as presses and man-on-man defences. Another example of a strategy would be playing a *baseline game* in tennis; how this is actually accomplished (i.e., the skills performed) would vary considerably over the course of a game. This questionnaire was designed to assess the extent to which you incorporate imagery into your sport. Any statement depicting a function of imagery that you rarely use should be given a **low rating**. In contrast, any statement describing a function of imagery which you use frequently should be given a **high rating**. Your ratings will be made on a seven-point scale, where *one* is the **rarely** or never engage in that kind of imagery end of the scale and *seven* is the **often** engage in that kind of imagery end of the scale. Statements that fall within these two extremes should be rated accordingly along the rest of the scale. Read each statement below and fill in the blank the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are practising or competing in your sport. Don't be concerned about using the same numbers repeatedly if you feel they represent your true feelings. Remember, there are no right or wrong answers, so please answer as accurately as possible.

| | | | | | | | | |
|--------|---|---|---|---|---|---|-------|--|
| Rarely | | | | | | | Often | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |

- (1) I make up new plans/strategies in my head. _____
- (2) I image the atmosphere of winning a championship (e.g., the excitement that follows winning a championship). _____
- (3) I image giving 100%. _____
- (4) I can consistently control the image of a physical skill. _____
- (5) I imagine the emotions I feel while doing my sport. _____
- (6) I imagine my skills improving. _____
- (7) I image alternative strategies in case my event/game plan fails. _____
- (8) I imagine myself handling the arousal and excitement associated with my sport. _____
- (9) I imagine myself appearing self-confident in front of my opponents. _____
- (10) I imagine other athletes congratulating me on a good performance. _____
- (11) I image each section of an event/game (e.g., offense vs. defence, fast vs. slow). _____

- (12) I imagine myself being in control in difficult situations. _____
- (13) I can easily change an image of a skill. _____
- (14) I image others applauding my performance. _____
- (15) When imaging a particular skill, I consistently perform it perfectly in my mind. _____
- (16) I image myself winning a medal. _____
- (17) I imagine the stress and anxiety associated with my sport. _____
- (18) I image myself continuing with my game/event plan, even when performing poorly.

- (19) When I image myself performing, I feel myself getting psyched up. _____
- (20) I can mentally make corrections to physical skills. _____
- (21) I imagine executing entire plays/programs/sections just the way I want them to happen in an event/game. _____
- (22) Before attempting a particular skill, I imagine myself performing it perfectly. _____
- (23) I imagine myself being mentally tough. _____
- (24) When I image myself participating in my sport, I feel anxious. _____
- (25) I imagine the excitement associated with performing. _____
- (26) I image myself being interviewed as a champion. _____
- (27) I image myself to be focussed during a challenging situation. _____
- (28) When learning a new skill, I imagine myself performing it perfectly. _____
- (29) I imagine myself successfully following my game/event plan. _____
- (30) I image myself working successfully through tough situations (e.g., a player short, sore ankle, etc.). _____

APPENDIX H

Shortened Sport Imagery Questionnaire (Study 2)

Athletes use mental imagery in training and competition. Imagery serves two functions. The motivational function of imagery can represent emotion-arousing situations as well as specific goals and goal-oriented behaviors. The cognitive function entails the mental rehearsal of skills and strategies of play. A strategy is a plan or method of achieving some goal. In sport, this often is referred to as a game plan. An example of a strategy used in curling would be playing a *defensively*; how this is actually accomplished (i.e., the shots executed) would vary considerably over the course of a game. This questionnaire was designed to assess the extent to which you incorporate imagery into curling. Any statement depicting a function of imagery that you rarely use should be given a low rating. In contrast, any statement describing a function of imagery which you use frequently should be given a high rating. Your ratings will be made on a seven-point scale, where *one* is the rarely or never engage in that kind of imagery end of the scale and *seven* is the often engage in that kind of imagery end of the scale. Statements that fall within these two extremes should be rated accordingly along the rest of the scale. Read each statement below and fill in the blank the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are practising or competing in curling. Don't be concerned about using the same numbers repeatedly if you feel they represent your true feelings. Remember, there are no right or wrong answers, so please answer as accurately as possible.

| Rarely | | | | | Often | | |
|--------|---|---|---|---|-------|---|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | |

- (1) I make up new plans/strategies in my head. _____
- (2) I can consistently control the image of a physical skill. _____
- (3) I imagine my skills improving. _____
- (4) I image alternative strategies in case my event/game plan fails. _____
- (5) I image each section of an event/game (e.g., offense vs. defence, early ends vs. late ends).

- (6) I can easily change an image of a skill. _____
- (7) When imaging a particular skill, I consistently perform it perfectly in my mind. _____
- (8) I image myself continuing with my game/event plan, even when performing poorly. _____
- (9) I can mentally make corrections to physical skills. _____
- (10) I imagine executing entire plays/programs/sections just the way I want them to happen in an event/game. _____
- (11) Before attempting a particular skill, I imagine myself performing it perfectly. _____
- (12) When learning a new skill, I imagine myself performing it perfectly. _____
- (13) I imagine myself successfully following my game/event plan. _____

APPENDIX I

Imagery Assessment Questionnaire (Study 2 and Study 3)

1. Are you using the imagery outlined in the script?

2. In the last week, how many times did you practice the imagery script?

3. On a scale from 1 to 10, how effective was your imagery session?

4. Did you change the imagery script to suit your individual need and if so, what did you image?

APPENDIX J

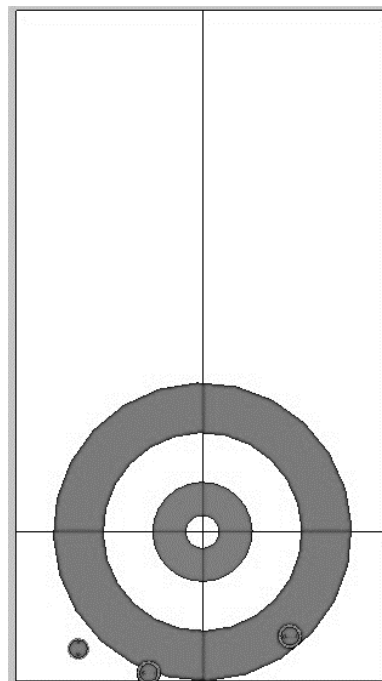
Imagery Scripts (Study 2)

Imagery Script #1

It is the **1st end** of a ten end game. You are shooting yellow rocks. The score is **0-0**. **You have last rock in this end**. Picture yourself standing in the house behind the back line. <PAUSE> Feel the cool air against your face as you take a few steps towards the back line. <PAUSE> As you look down to the other end of the sheet, you see that your **vice** is settled in the hack, ready to throw their **first rock** of the end.

You do not have any rocks in play, but there are three red rocks at the back of the house. <PAUSE> The red rock that is shot is sitting fully in the back 12-foot on the right side. <PAUSE> A second red rock is biting the back 12-foot on the left side. <PAUSE> Finally, there is a third red rock just ahead and to the left of the one that is second shot, but is not in the rings. <PAUSE>

As you look around the house, you think about different shots you could have your **vice** play. <PAUSE> First, you could call for your **vice** to hit the shot rock on the right side of the house and roll to the left in front of the one that is second shot. <PAUSE> Your second option is to freeze to the shot rock on the right side of the sheet. <PAUSE> A third option is to draw to the T-line in front of one of the red rocks. <PAUSE> Your final option is to play a double takeout, leaving your rock sitting in the back 12-foot on the left side. <PAUSE> Considering the four options, think about what shot you would call and see your **vice** throwing and making that shot.

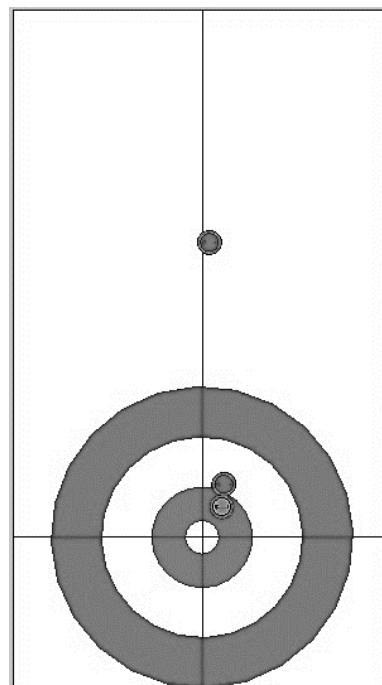


Imagery Script #2

It is the **2nd end** of a ten end game. You are shooting yellow rocks. The score is **0-0**. **You have last rock in this end**. Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **lead** is settled in the hack, ready to throw their **second rock** of the end.

There are two rocks in the house. You are shot, with one yellow rock sitting fully in the top 4-foot on the right side of the sheet. *<PAUSE>* Your opponent has a red rock frozen to the yellow rock, leaving it biting the top 4-foot. *<PAUSE>* There is also a red guard touching the centre line on the right side, leaving the red rock in the house half open. This guard is sitting halfway between the hog line and the house.

As you look around the house, you think about different shots you could have your **lead** play. *<PAUSE>* First, you could call for your **lead** to freeze to the red rock on the right side of the sheet. *<PAUSE>* Your second option is to tap the red rock onto the yellow rocks to move them around. *<PAUSE>* A third option is to draw to the left side of the house. *<PAUSE>* Your final option is to guard the red and yellow rock, so your opponent cannot play a nose hit to the sit two. *<PAUSE>* Considering the four options, think about what shot you would call and see your **lead** throwing and making that shot.

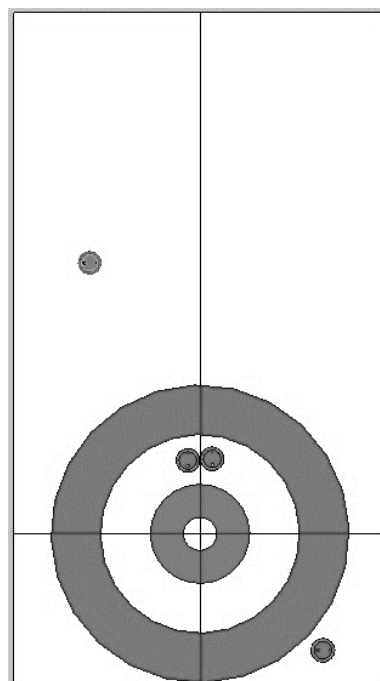


Imagery Script #3

It is the **8th end** of a ten end game. You are shooting yellow rocks. The score is **6-4 (you are up 2)**. **You do not have last rock in this end**. Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **vice** is settled in the hack, ready to throw their **second rock** of the end.

There are two rocks in the house. Your opponent has two red rocks even with each other fully in the top 8-foot on either side of the centre line. *<PAUSE>* You have a yellow corner guard halfway between the hogline and the house covering the 12-foot on the left side of the house. *<PAUSE>* There is also a red rock outside of the rings just past the back 12-foot on the right side of the house.

As you look around the house, you think about different shots you could have your **vice** play. *<PAUSE>* First, you could call for your **vice** to play a double takeout by hitting where the two red rocks are touching (the middle). *<PAUSE>* Your second option is to play a double takeout by hitting the outside half of the red rock on the right side of the house. *<PAUSE>* A third option is to draw to the 4-foot behind the two red rocks. *<PAUSE>* Your final option is to play a nose hit on the red rock on the right side. *<PAUSE>* Considering the four options, think about what shot you would call and see your **vice** throwing and making that shot.



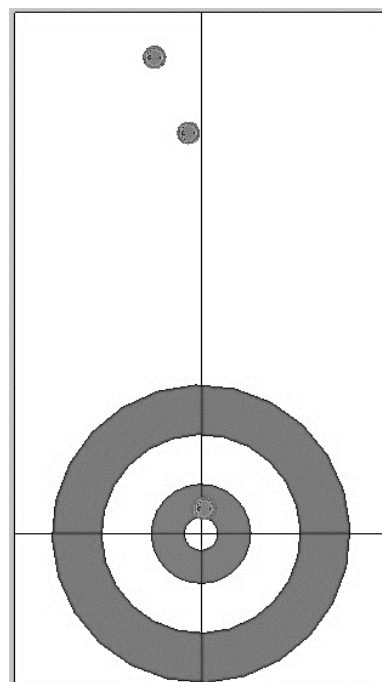
Imagery Script #4

It is the **10th end** of a ten end game. You are shooting yellow rocks. The score is **4-6 (you are down 2)**. **You do not have last rock in this end**. Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **second** is settled in the hack, ready to throw their **second rock** of the end.

There is one rock in the house. You have a yellow rock biting the top of the button on the centre line. *<PAUSE>* You also have two guards. One guard is 1/3 of the way past the hogline biting the centre line. *<PAUSE>* There is another yellow guard a foot over the hogline covering the edge of the 4-foot on the left side of the sheet.

As you look around the house, you think about different shots you could have your **second** play. *<PAUSE>*

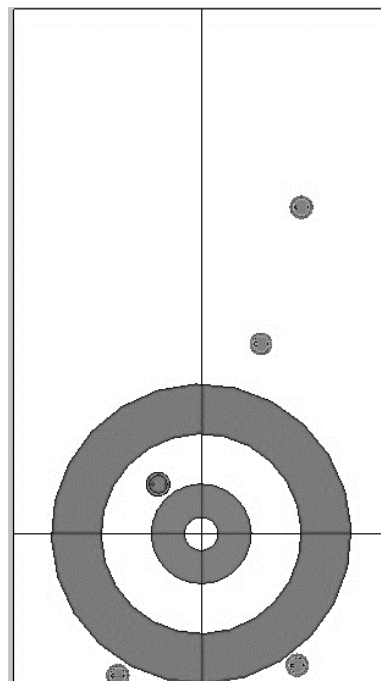
First, you could call for your **second** to freeze to the yellow rock. *<PAUSE>* Your second option is to tap the yellow rock to the back of the button. *<PAUSE>* A third option is to guard the shot rock, playing a guard tight to the rings. *<PAUSE>* Your final option is to play a split on the yellow rock in the house, tapping it behind the two guards. *<PAUSE>* Considering the four options, think about what shot you would call and see your **second** throwing and making that shot.



Imagery Script #5

It is the **9th end** of a ten end game. You are shooting yellow rocks. The score is **3-6 (you are down 3)**. **You have last rock in this end.** Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **first rock** of the end.

There is one rock in the house. Your opponents have a red rock in the top 8-foot on the left side of the house sitting a couple inches away from biting the top 4-foot. *<PAUSE>* You have two guards on the right side of the sheet. The first guard is tight to the rings covering the inside edge of the 8-foot. *<PAUSE>* The second guard is halfway between the hogline and the house, covering the edge of the 8-foot. *<PAUSE>* There are two yellow rocks at the back of the house (but not counting), one on each side. The first rock is on the left side of the house and is touching the backline and sitting in line with the edge of the 8-foot. *<PAUSE>* The second rock is on the right side of the house just outside the rings, and is lined up with the edge of the 8-foot.

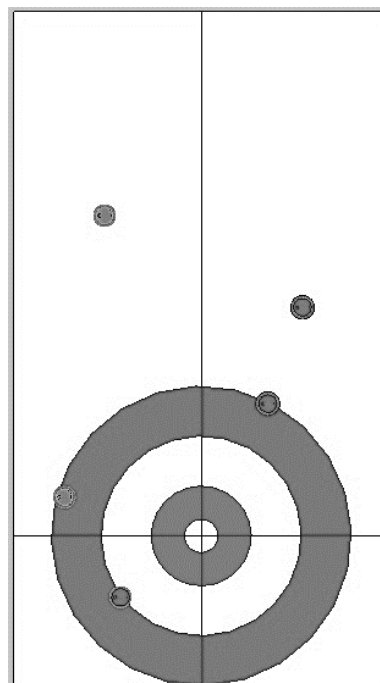


As you look around the house, you think about different shots that your **skip** could play. *<PAUSE>* First, your **skip** could play a straight peel on the red rock, removing it and your shooter from the rings. *<PAUSE>* Your second option is to play a hit and roll behind one of the yellow guards. *<PAUSE>* A third option is tap the red rock to the back of the house. *<PAUSE>* Your final option is to draw behind the two corner guards. *<PAUSE>* Considering the four options, think about what shot you would call and see your **skip** throwing and making that shot.

Imagery Script #6

It is the **10th end** of a ten end game. You are shooting yellow rocks. The score is **7-8 (you are down 1)**. **You do not have last rock in this end**. Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **last rock** of the end.

You have a corner guard halfway between the hogline and the house covering the edge of the 8-foot on the left side of the sheet. *<PAUSE>* Your opponent has a corner guard on the right side of the sheet four feet in front of the house covering the inside edge of the 12-foot. *<PAUSE>* There are three rocks in the house. Your opponent is shot, with a red rock biting the back 8-foot on the left side of the house, not covered by the guard. *<PAUSE>* You are second shot, with a yellow rock just fully sitting in the 12-foot on the left side of the sheet in front of the T-line. *<PAUSE>* There is also a red rock halfway on the top 12-foot on the right side of the house, in line with the 8-foot.

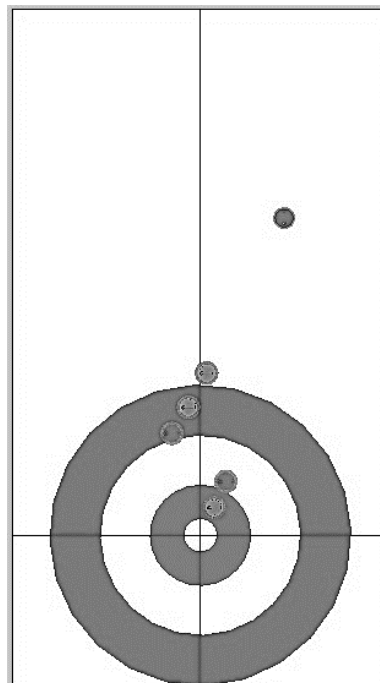


As you look around the house, you think about different shots that your **skip** could play. *<PAUSE>* First, your **skip** could draw to the edge of the 4-foot behind the red rock that is third shot. *<PAUSE>* Your second option is to freeze to the shot rock on the back 8-foot. *<PAUSE>* A third option is to tap the shot rock to the back of the house to sit two. *<PAUSE>* Your final option is to play a hit and roll of the shot rock. *<PAUSE>* Considering the four options, think about what shot you would call and see your **skip** throwing and making that shot.

Imagery Script #7

It is the **3rd end** of a ten end game. You are shooting yellow rocks. The score is **3-2 (you are up 1)**. **You have last rock in this end.** Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **second** is settled in the hack, ready to throw their **second rock** of the end.

Your opponent has a corner guard halfway between the hogline and the house covering the edge of the 8-foot on the right side of the sheet. *<PAUSE>* You have a centre guard just in front of the rings touching the centre line but mostly on the right side of the sheet. *<PAUSE>* There are four rocks in the house. You are shot, with a yellow rock in the top 4-foot on the right side of the house. *<PAUSE>* Your opponent is second shot, corner frozen to your shot rock on the right side. *<PAUSE>* Your opponent is also third shot, just biting the top 8-foot on the left side of the house covering the 4-foot. *<PAUSE>* You are fourth shot, with a yellow rock in the top 12-foot, corner frozen to the red rock biting the top 8-foot.

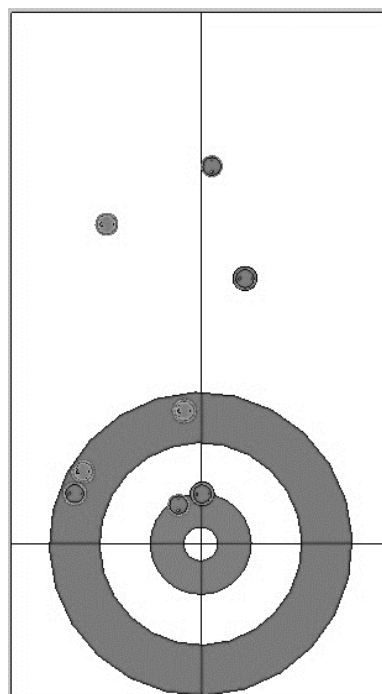


As you look around the house, you think about different shots that your **second** could play. *<PAUSE>* First, your **second** could play a guard halfway between the hogline and the house covering the red rock that is second shot. *<PAUSE>* Your second option is to tap the red rock biting the top 4-foot. *<PAUSE>* A third option is to hit your centre guard. *<PAUSE>* Your final option is to freeze to the red rock biting the 4-foot. *<PAUSE>* Considering the four options, think about what shot you would call and see your **second** throwing and making that shot.

Imagery Script #8

It is the **4th end** of a ten end game. You are shooting yellow rocks. The score is **2-4 (you are down 2)**. **You do not have last rock in this end**. Picture yourself standing in the house behind the back line. *<PAUSE>* Feel the cool air against your face as you take a few steps towards the back line. *<PAUSE>* As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **last rock** of the end.

Your opponent has two centre guards. One is touching the centre line halfway between the hogline and the house. The other centre guard is four feet in front of the house covering the edge of the 4-foot on the right side of the sheet. *<PAUSE>* You have a corner guard halfway between the hogline and the house covering the edge of the 8-foot on the left side of the sheet. *<PAUSE>* There are five rocks in the house. Your opponent is sitting two for sure, with two rocks almost fully in the top 4-foot – one to the left of the centre line and the other corner frozen to it on the right side, bisecting the centre line. *<PAUSE>* It is unclear who is third shot out of the remaining three rocks. You have a rock in the top 12-foot to the left of the centre line. *<PAUSE>* Your opponent has a red rock in the top 12-foot on the left side of the house. *<PAUSE>* You have another yellow rock corner frozen on top of that red rock.



As you look around the house, you think about different shots that your **skip** could play. *<PAUSE>* First, your **skip** could draw for 1 point with no backing. *<PAUSE>* Your second option is to play a counter clockwise hit on the red rock that is open, giving up 1. *<PAUSE>* A third option is to play a runback using the yellow rock at the top of the house. *<PAUSE>* Your final option is to play a clockwise double takeout through a port on the left side of the house. *<PAUSE>* Considering the four options, think about what shot you would call and see your **skip** throwing and making that shot.

APPENDIX K

Social Validation Questionnaire (Study 3)

1. How important is an improvement in overall strategy performance to you?

| | | | | | | |
|------------|---|---|---|---|---|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |
| Not at all | | | | | | Extremely |
| important | | | | | | important |

2. Do you consider the changes in your strategy performance to be significant?

| | | | | | | |
|-------------|---|---|---|---|---|-------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |
| Not at all | | | | | | Extremely |
| significant | | | | | | significant |

3. How satisfied were you with the imagery training program?

| | | | | | | |
|------------|---|---|---|---|---|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |
| Not at all | | | | | | Extremely |
| satisfied | | | | | | satisfied |

4. Has the imagery intervention proved useful to you?

| | | | | | | |
|------------|---|---|---|---|---|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |
| Not at all | | | | | | Extremely |
| useful | | | | | | useful |

5. If the procedure have contributed to changing your levels of strategy performance, can you state why you perceive this to be the case?

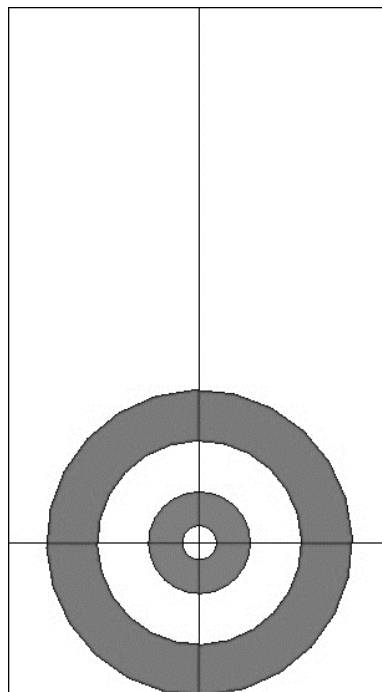
APPENDIX L

Imagery Scripts (Study 3)

Imagery Script – Week 1

Picture yourself standing at the far end of your favourite sheet of ice at your home curling club. You are about to call **the first shot of the game** and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **1st end** of a ten end game. You are shooting yellow rocks and the score is **0-0**. <PAUSE> **You do not have last rock in this end** and have chosen to play **defensively**, which means you want to play this end cautiously, and keep the playing area as clean and open as possible. <PAUSE> As you look down to the other end of the sheet, you see that your **lead** is settled in the hack, ready to throw the **first rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **lead's first stone**.



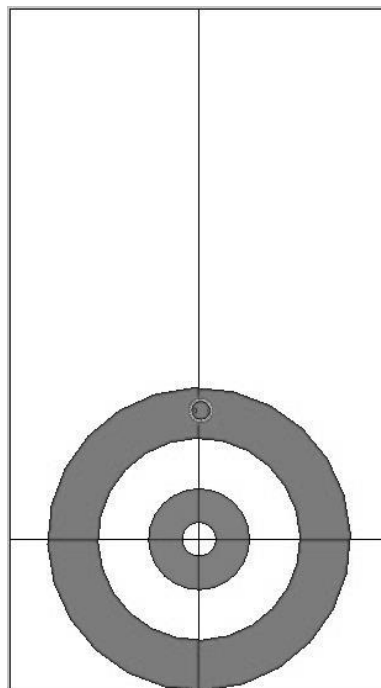
Because this is the first rock of the game, there are no rocks in play, just a wide open sheet. <PAUSE> Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE>

As you look around the house, you think about different shots you could have your **lead** play. <PAUSE> First, you could call for your **lead** to draw to the T-line on one side of the house. <PAUSE> Your second option is to call for a high centre guard, close to the hog line. <PAUSE> A third option is to play a tight centre guard, close to the top of the rings. <PAUSE> Your final option is to draw top the top 4-foot on the centre line. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **defensive strategy plan** and see your **lead** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 2

Picture yourself standing at the far end of your favourite sheet of ice at your home curling club. You are about to call **your first shot of the game** and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **1st end** of a ten end game. You are shooting yellow rocks and the score is **0-0**. <PAUSE> **You have last rock in this end** and have chosen to play **offensively**, which means you want to play this end aggressively, and have a lot of rocks in play. <PAUSE> As you look down to the other end of the sheet, you see that your **lead** is settled in the hack, ready to throw their **first rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **lead's first stone**.



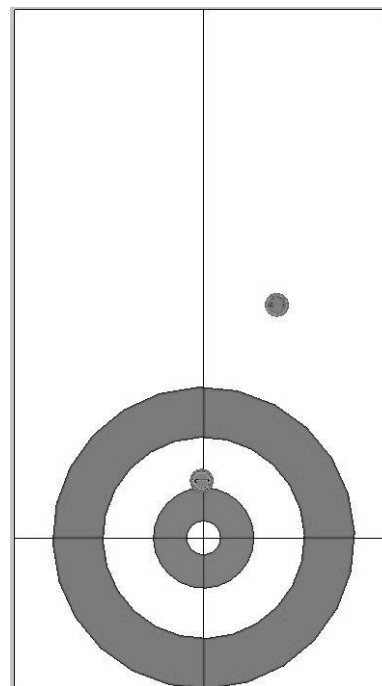
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There is only one rock in the house; a red rock in the top 12-foot intersecting the centre line. <PAUSE>

As you look around the house, you think about different shots you could have your **lead** play. <PAUSE> First, you could call for your **lead** to throw a corner guard, halfway between the hog line and the rings. <PAUSE> Your second option is to play a nose hit on your opponent's rock sitting at the top of the house, in the 12-foot ring. <PAUSE> A third option is to freeze to the red rock. <PAUSE> Your final option is to play a centre guard, covering your opponent's rock. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **offensive strategy plan** and see your **lead** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 3

Picture yourself standing at the near end of your favourite sheet of ice at your home curling club. You are about to call **your second shot of the end** and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **4th end** of a ten end game. You are shooting yellow rocks and the score is **4-3 (you are up 1 point)**. <PAUSE> **You do not have last rock in this end** and have chosen to play **a blended strategy**, which means you want to play this end conservatively, but will go for the chance to score a lot of points if you can do so safely. <PAUSE> As you look down to the other end of the sheet, you see that your **lead** is settled in the hack, ready to throw their **second rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **lead's second stone**.



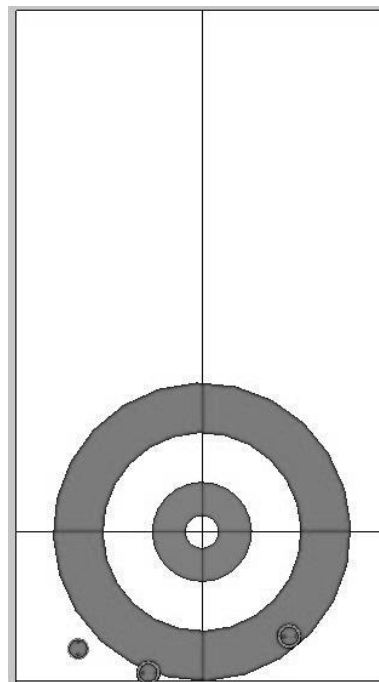
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There is a yellow rock in the house, just biting the top 4-foot on the center line. <PAUSE> There is also a red corner guard, about four feet in front of the rings on the right side of the sheet. <PAUSE>

As you look around the house, you think about different shots you could have your **lead** play. <PAUSE> First, you could call for your **lead** to throw a center guard, halfway between the hog line and the rings. <PAUSE> Your second option is to draw around the red corner guard to the top of the house. <PAUSE> A third option is to freeze to the yellow rock, leaving that rock sitting in the top 8-foot on the center line. <PAUSE> Your final option is to play a second corner guard, on the left side of the sheet. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **blended strategy plan** and see your **lead** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 4

Picture yourself standing at the far end of your favourite sheet of ice at your home curling club. You are about to call **your vice's first shot** of the end and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **1st end** of a ten end game. You are shooting yellow rocks and the score is **0-0**. <PAUSE> **You have last rock in this end** and have chosen to play a **defensively**, which means you want to play this end cautiously, and keep the playing area as clean and open as possible. <PAUSE> As you look down to the other end of the sheet, you see that your **vice** is settled in the hack, ready to throw their **first rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **vice's first stone**.



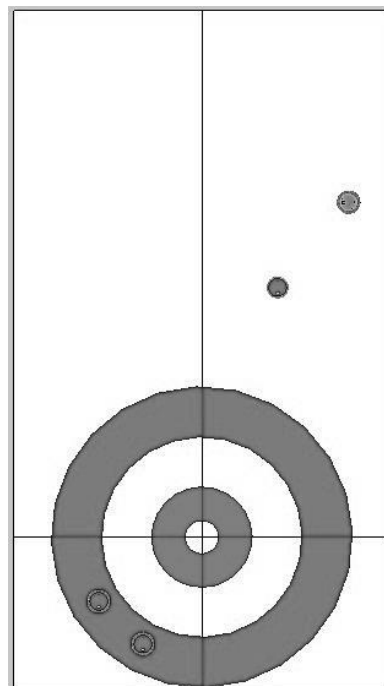
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There are no guards in front of the house. <PAUSE> There are three red rocks in the back of the house. <PAUSE> The shot rock is on the right side, just fully sitting in the back 12-foot, directly behind where edge of the 8-foot ring intersects the T-line. <PAUSE> The second red rock is biting the back 12-foot on the left, directly behind where the edge of the 4-foot ring intersects the T-line. <PAUSE> The third red rock is not in the rings, but is sitting on the left side of the sheet, directly behind where the edge of the 12-foot ring intersects the T-line and to the left of the two red rocks in the rings.

As you look around the house, you think about different shots you could have your **vice** play. <PAUSE> First, you could call for your **vice** to play a hit and roll off the shot rock on the right side of the rings. <PAUSE> Your second option is to freeze to the shot rock on the right side of the rings. <PAUSE> A third option is to draw to the T-line, in front of one of the red rocks. <PAUSE> Your final option is to draw to the back 8-foot on the left side, in front of the rock that is second shot. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **defensive strategy plan** and see your **vice** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 5

Picture yourself standing at the near end of your favourite sheet of ice at your home curling club. You are about to call **your skip's first shot** of the end and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **4th end** of a ten end game. You are shooting yellow rocks and the score is **4-3 (you are up 1 point)**. <PAUSE> **You have last rock in this end** and have chosen to play **offensively**, which means you want to play this end aggressively, and have a lot of rocks in play. <PAUSE> As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **first rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **skip's first stone**. <PAUSE>



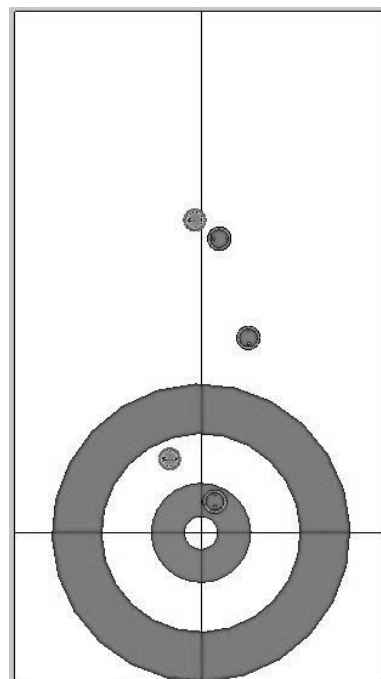
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There are two red rocks in the house. <PAUSE> They both appear to be shot, both in the back 12-foot on the right side of the house. <PAUSE> The higher red rock appears to be just outside of the edge of the 8-foot, where it intersects the T-line. <PAUSE> The second red rock is directly behind where the edge of the 4-foot intersects the T-line and to the left of where the edge of the 8-foot intersects the centre line. <PAUSE> There is a red corner guard on the right side of the sheet, four feet in front of the rings and directly in front of the 8-foot. <PAUSE> There is also a yellow corner guard higher than the red guard on the right side, halfway between the hog line and the house, closer to the edge of the sheet. <PAUSE>

As you look around the house, you think about different shots you could have your **skip** play. <PAUSE> First, you could call for your **skip** to draw behind the red guard on the right side of the house. <PAUSE> Your second option is to freeze to one of the red rocks in the back of the rings on the left side of the house. <PAUSE> A third option is to hit the top red rock and roll in front of the second one. <PAUSE> Your final option is to draw to the T-line in front of the two red rocks. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **offensive strategy plan** and see your **skip** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 6

Picture yourself standing at the far end of your favourite sheet of ice at your home curling club. You are about to call **your skip's first shot** of the end and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **7th end** of a ten end game. You are shooting yellow rocks and the score is **tied, 5-5**. <PAUSE> **You have last rock in this end** and have chosen to play **a defensively**, which means you want to play this end cautiously, and keep the playing area as clean and open as possible. <PAUSE> As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **first rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **skip's first stone**.



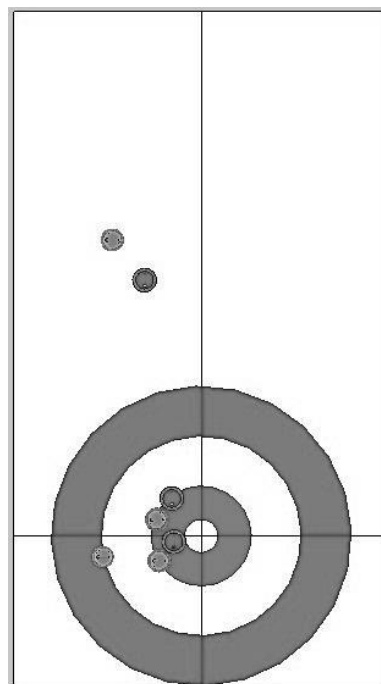
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> <PAUSE> Red is shot, sitting in the top 4-foot biting the centre on the right side. <PAUSE> There is a yellow rock in the top 8-foot on the left side of the house, angled above the red rock. <PAUSE> There are three guards in front of the rings. A yellow centre guard biting the centre line on the left side, halfway between the hog line and the house. <PAUSE> A second red centre guard is slightly closer to the rings and just off the centre line on the right side of the sheet. <PAUSE> A third red guard is two feet in front of the rings on the right side of the sheet, in line with the outside edge of the 4-foot. <PAUSE>

As you look around the house, you think about different shots you could have your **skip** play. <PAUSE> First, you could call for your **skip** to tap the yellow rock on the left side of the house to the T-line. <PAUSE> Your second option is to play an angle-raise takeout, hitting the outside half of the yellow rock to send it into the red rock that is shot. <PAUSE> A third option is to freeze to the top of the red rock that is shot. <PAUSE> Your final option is to play a runback/double takeout using the red guard just in front of the house on the right side of the sheet. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **defensive strategy plan** and see your **skip** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 7

Picture yourself standing at the far end of your favourite sheet of ice at your home curling club. You are about to call your **vice's second shot** of the end and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **9th end** of a ten end game. You are shooting yellow rocks and the score is **7-5 (you are up 2 point)**. <PAUSE> **You do not have last rock in this end** and have chosen to play **offensively**, which means you want to play this end aggressively, and have a lot of rocks in play. <PAUSE> As you look down to the other end of the sheet, you see that your **vice** is settled in the hack, ready to throw their **second rock** of the end. <PAUSE>



See your sweepers at the other end of the sheet, preparing to brush your **vice's second stone**. <PAUSE>

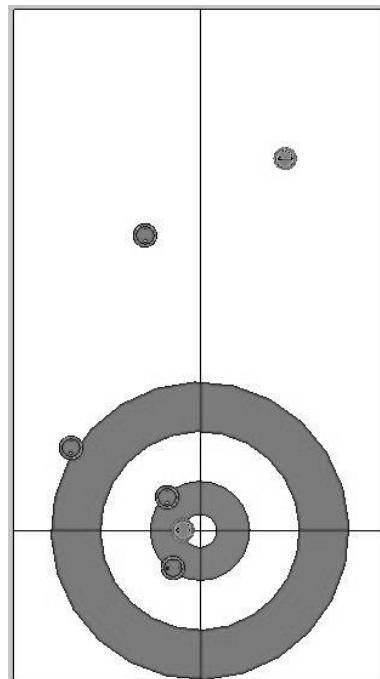
Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There are two corner guards halfway between the hog line and the house on the left side of the sheet. A red corner guard is two feet of the centre line, covering the edge of the 4-foot. <PAUSE> A yellow corner guard is four feet off the centre line, covering the edge of the 8-foot. <PAUSE> Red is shot; just behind the T-line and biting the left edge of the button. <PAUSE> It is corner-frozen to a yellow rock that is half on the back 4-foot and half on the back 8-foot. <PAUSE> Frozen to the shot rock is a second yellow rock that is directly in front of the other yellow, just in front of the T-line. <PAUSE> There is a second red rock corner frozen on the right side of that yellow rock, biting the top 4-foot. These four rocks are making a zigzag-like pattern. <PAUSE> Finally, there is a yellow rock on the left side of the house, biting the back 8-foot, just behind the T-line.

As you look around the house, you think about different shots you could have your **vice** play. <PAUSE> First, you could call for your **vice** to play a nose hit on the red rock at the top of the house. <PAUSE> Your second option is to peel the red guard. <PAUSE> A third option is to freeze to the red rock on the T-line, with the goal of becoming shot. <PAUSE> Your final option is to play a tap on the red rock at the top of the house, hitting it on the nose. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **offensive strategy plan** and see your **vice** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

Imagery Script – Week 8

Picture yourself standing at the near end of your favourite sheet of ice at your home curling club. You are about to call **your last shot of the game** and are standing behind the back line. <PAUSE> Feel the cool air against your face as you grip your broom and take a few steps towards the back line. <PAUSE> Hear the sounds of the other sheets; rocks sliding down the ice, skips calling line, rocks hitting each other as one is removed from the rings. <PAUSE> Push those noises into the background as you turn your attention back to your sheet of ice.

It is the **10th end** of a ten end game. You are shooting yellow rocks and the score is **8-7 (you are up 1 point)**. <PAUSE> **You do not have last rock in this end** and have chosen to play a **blended strategy**, which means you want to play this end conservatively, but will go for the chance to score a lot of points if you can do so safely. <PAUSE> As you look down to the other end of the sheet, you see that your **skip** is settled in the hack, ready to throw their **second rock** of the end. <PAUSE> See your sweepers at the other end of the sheet, preparing to brush your **skip's second stone**.



Visualize the playing area; imagine the colours of the button, the 4-foot ring, 8-foot and 12-foot. <PAUSE> There are two corner guards in front of the house. On the right side, a yellow corner guard is sitting six feet past the hog line, covering the outside edge of the 8-foot. <PAUSE> There is a red corner guard on the left side of the sheet, halfway between the hog line and the house, just covering the outside edge of the 4-foot. <PAUSE> Yellow is shot, with a rock on the T-line, sitting half on the left side of the button and half on the 4-foot ring. <PAUSE> There are two red rocks both in front of and behind that yellow rock, both biting the 4-foot ring on the left side of the house. <PAUSE> There is a third red rock biting the top 12-foot on the left side of the house, directly to the left of the top edge of the 8-foot ring. <PAUSE>

As you look around the house, you think about different shots you could have your **skip** play. <PAUSE> First, you could call for your **skip** to play a corner freeze on the right side of the red rock biting the top 4-foot. <PAUSE> Your second option is to play a hit and roll of the red rock biting the top 4-foot. <PAUSE> A third option is play a centre line guard. <PAUSE> Your final option is to draw to the top 12-foot on the centre line. <PAUSE> Considering the four options, see yourself calling the shot that falls in line with your **blended strategy plan** and see your **skip** delivering the rock and your sweepers brushing it down the sheet to help make the shot.

APPENDIX M

Interview Guide (Study 4)

1. Welcome:

- a. Thank you for taking the time to join the discussion group on imagery use in curling. My name is Despina Kouali. Assisting me is Nicole Westlund.

2. Guidelines:

- a. Before we begin, let me suggest some ways in which the discussion will go smoothly. You will be audio-taped because we don't want to miss any of your comments. Be sure to speak loudly enough and only one at a time. We will use your first names here today, but in a report that we write after we collect all our data, your names will not be used so that no one will know who made the comments.
- b. My role is to ask questions and listen. I won't be participating in the conversation, but I want you to feel free to speak with one another. I will be asking about 5 questions and I'll be moving the discussion from one question to the next. We will be done in about 45 minutes. It is important that I hear from each of you because you each have different experiences when you are active. So if one of you is sharing a lot, I may ask if others have something to share as well. And if you aren't saying too much, I may ask if you have something to add. We've placed name cards on the table in front of you to help us remember each other's names.

3. Getting to Know You: (approximately 3 minutes)

- a. Opening Question: Let's find out some more about each of you by going around the table. Please state your name age, and for how long have you curled and for how long have you played the position of skip.

4. Overview of the topic: (approximately 5 minutes)

- a. We want to hear how you use imagery when playing curling
- b. Have you ever heard of imagery? What do you think it is?
- c. Give a definition of imagery: The following is a definition of imagery: "*...an experience that mimics real experience. When can be aware of "seeing" an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing. Sometimes people find that it helps to close their eyes. It differs from dreams in what we are awake and conscious when we form an image*".
- d. We are going to focus only on one type of imagery, the Cognitive General imagery.
- e. I'll be asking questions such as where, when, and why you use CG imagery and what you image. Cognitive General (CG) imagery refers to game plans and strategies.
- f. There are no right or wrong answers. Please feel free to say what you like, even if it is different from another person's point of view.

5. Introductory Questions (approximately 5 minutes)

- a. When was your first time using CG imagery? Can you tell us about this experience?

6. Key Questions: (approximately 25 minutes)

- a. Where do you use CG imagery? (approximately 5 minutes)

- Probe: Describe how you use CG imagery during practice?
- Probe: Describe how you use CG imagery during competition?
- b. When do you most often use CG imagery? (approximately 5 minutes)
 - Probe: Describe how you use CG imagery before competition?
 - Probe: Describe how you use CG imagery after competition?
 - Probe: Describe how you use CG imagery on the ice?
 - Probe: Describe how you use CG imagery off the ice?
- c. Why do you use imagery? (approximately 5 minutes)
- d. What are the reasons for using CG imagery?
 - Probe: Describe how would you use CG imagery to rehearse and execute different game strategies?
 - Probe: Describe how would you use CG imagery to plan a strategy?
 - Probe: Describe how would you use CG imagery to predict opponent's strategy?
 - Probe: Describe how would you use CG imagery to review a game?
- e. Describe what do you image while you are playing? (approximately 10 minutes)
 - Probe: Do you see your teammates or your opposition throwing the rocks or do you see only the rocks moving?
 - Probe: Do you see the playing area from above or behind the house while you are using CG imagery?
 - Probe: How vivid is what you image?
 - Probe: How do you feel while you are using CG imagery?
 - Probe: What types of positive CG imagery do you use?
 - Probe: What types of negative CG imagery do you use?
 - Probe: Describe how you see colours? Is it black or white?
 - Probe: What senses do you use?

7. Summary: (approximately 3 minutes)

- a. Summarize the most important findings (refer to assistant). Capture common themes but acknowledge different points of view.
 - Probe: Is there anything that we should have talked about and didn't?
 - Probe: Did we miss anything?

8. Conclusion: (approximately 2 minutes)

- a. I want to thank you for sharing so much information about yourself and your experiences. I want to assure you again that this information will be treated in the strictest confidence. Thank you for your time.

APPENDIX N

Letters of Information and Consent Forms

Curling Strategy Evaluation: Letter of Information and Consent

(Study 1: Phase 1)

You are being invited to evaluate a number of curling scenarios that I have developed for this study. I will be using some of these scenarios in future imagery intervention studies to test the accuracy and efficiency with which varsity-level curlers can choose the correct shot option for each given scenario and track these skills over the course of a season.

In order to be eligible to participate, you must be over the age of 18 and curl either competitively or as part of a structured curling league. If you meet the inclusion criteria for this study and agree to take part in this research, you will be asked to fill out a short demographic questionnaire, followed by an evaluation of 75 different curling scenarios. Each scenario will include:

- A picture of the rocks in the house and a written description of the end of play in a **10 end game**
- The score of the game
- Who on your team is shooting
- Whether it is their first or second shot.
- Assume normal ice conditions and that all shooters play at a varsity level

You will be provided with four shot options. Please select which shot option you think is the most correct shot to call for that given situation. If you think that none of the four shot options is the best solution or if there are more than one correct option, please indicate which shot should be chosen and explain why in the "Other" response option.

This entire process will take approximately 60 minutes to complete. After you complete 15 scenarios, you will be presented with a "break" page. This will allow you to step away from your computer if you wish before you continue with the remaining scenarios. **Be sure to keep the window open though!**

Your participation in this study is completely voluntary. Your agreement to participate in this study is indicated by completing this questionnaire. You may refuse to participate, refuse to answer any question or withdraw from the study at any time with no effect on your status at Western if you are a student there. There are no known risks associated with your participation in this study. If you chose to participate in this study, you will help in the development of a way to evaluate curlers' strategy abilities in game-like situations.

All data collected in the study are anonymous. If the results of this study are published, your name will not be used and no information that discloses your identity will be published. Your questionnaire results will be stored in a locked cabinet in a secure room and will be destroyed after three years.

Please print this page for your records. If you have any questions, or would like more information about this study, please do not hesitate to contact the investigators listed below. If you have any questions about the ethical conduct of this study or your rights as a research subject, you may contact: Office of Research Ethics, Western University.

Thank you!
Investigators:

Nicole Westlund
MA Candidate, School of Kinesiology
The University of Western Ontario

Dr. Craig Hall
Professor, School of Kinesiology
The University of Western Ontario

Project Title: Item Validation for the Curling Strategy Assessment Tool

Investigators: Nicole Westlund, MA, & Craig Hall, PhD, Western University

Letter of Information

(Study 1: Phase 2)

1. Invitation to Participate

You are being invited to participate in a study titled “Item Validation for the Curling Strategy Assessment Tool.”

2. Purpose of the Letter

The purpose of this letter is to provide you with information required for you to make an informed decision regarding participation in this research.

3. Purpose of this Study

The purpose of this study is to validate the scenarios that have been developed to test athletes’ decision making abilities regarding strategy in curling.

4. Inclusion Criteria

Individuals who are designated national-level coaches (either certified or in training) and are over the age of 18.

5. Exclusion Criteria

Individuals who hold a designation below a national-level curling coach or are under the age of 18.

6. Study Procedures

If you agree to take part in this study, you will be asked to participate in one 2-hour focus group that will help validate the 92 curling scenarios that I have developed for the Curling Strategy Assessment Tool. You will be asked to engage in discussion with the other coaches to help decide on the *most correct answer* for each curling scenario. A 10-15 minute break will be provided halfway through the focus group to give you a chance to get up and move around if needed.

7. Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

8. Possible Benefits

A potential benefit you might receive for participating in this study might be the opportunity to enhance your own coaching knowledge in regards to teaching strategy and tactics to your athletes through brainstorming with other national-level curling coaches.

9. Compensation

You will not be compensated for your participation in this research.

10. Voluntary Participation

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your coaching status. You will also have the option of having all data removed from the study and be destroyed if you decide to withdraw from the study.

11. Confidentiality

All data collected will remain confidential and accessible only to the investigators of the study. If the results of the study are published, only your age, gender and coaching experience will be used but will be discussed in a group context. While we do our best to protect your information, there is no guarantee that we will be able to do so. Your data will be stored in a password-protected computer that can only be accessed by the investigators and will be destroyed after five years.

12. Contacts for Further Information

If you require any further information regarding this research project or your participation in the study you may contact Nicole Westlund. If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics.

13. Publication

If the results of the study are published, your name will not be used. If you would like to receive a copy of any potential study results, please contact Nicole Westlund.

Thank you!

Investigators:

Nicole Westlund
PhD Candidate, School of Kinesiology
Western University

Dr. Craig Hall
Professor, School of Kinesiology
Western University

This letter is yours to keep for future reference.

Project Title: Item Validation for the Curling Strategy Assessment Tool

Investigators: Nicole Westlund, MA, & Craig Hall, PhD, Western University

Consent Form

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Participant's Name (please print): _____

Participant's Signature: _____

Date: _____

Person Obtaining Informed Consent (please print): _____

Signature: _____

Date: _____

An Evaluation of an Imagery Training Program with Varsity Curlers

Letter of Information

(Study 2)

You are being invited to participate in a study titled “An Evaluation of an Imagery Training Program with Varsity Curlers.” Imagery is one of the most popular techniques in psychological skills training programs (Short et al., 2002). It involves the mental simulation of performing physical skills, which can cause changes in motor learning, cognition, affect, and behaviour (Martin et al., 1999). Little attention has been paid by researchers on the mental skills used by competitive curlers, especially at the varsity level. Thus, this study aims to evaluate the effectiveness of a season-long imagery training program conducted with varsity curlers.

If you agree to take part in this research you will be asked to complete a questionnaire package including; the Movement Imagery Questionnaire-Revised (MIQ-R) which examines your ability to engage in mental imagery, and the Sport Imagery Questionnaire (SIQ), which assesses the types of imagery you engage in. You will also be asked to complete a computerized strategy evaluation, which will test your ability to choose the correct shot to call in a given situation, as well as the time it takes you to select the correct shot. This process will take approximately 30 minutes to complete. The imagery training program will consist of 12 sessions that will take place prior to your team’s scheduled practices at the Highland Country Club. At each imagery session, you will be asked to fill out the Imagery Assessment Questionnaire, which assesses your imagery use in the previous week. All of this will take 20 minutes. In addition, you will be given copies of the imagery script to take home and practice on your own as well as record your imagery practice in a journal. After the 12 imagery sessions have been completed, you will be asked to fill out the same questionnaire package, as well as complete the computerized strategy evaluation a second time.

Your participation in this study is completely voluntary. Your agreement to participate in this study is indicated by completing and signing the attached consent form. You may refuse to participate, refuse to answer any question or withdraw from the study at any time without affecting your status on the varsity curling team. If you decide to withdraw from the study, you will no longer be required to arrive at the curling club 20 minutes prior to practice. As well, you will be able to warm up for practice while the rest of the participants are participating in the imagery sessions in a different room. You will also have the option of having all data removed from the study and be destroyed if you decide to withdraw from the study or miss a significant number of imagery sessions.

There are no known risks associated with your participation in this study. If you chose to participate in this study, you will help to provide an understanding of how varsity curling teams use imagery and how its use can be improved over the course of the curling season. All data

collected in the study is anonymous. You will be assigned a subject number in order to track your data across the intervention. If the results of this study are published, only the subject number will be used however you may be identifiable according to your position played. Every effort will be made to avoid individual subjects being identified in the results. Your questionnaire results will be stored in a locked cabinet in a secure room and will be destroyed after three years.

This letter is yours to keep. If you have any questions, or would like more information about this study, please do not hesitate to contact the investigators listed below. If you have any questions about the ethical conduct of this study or your rights as a research subject, you may contact: The Director, Office of Research Ethics, The University of Western Ontario.

Thank you!

Investigators:

Dr. Craig Hall, PhD
Professor, School of Kinesiology
Western University

Nicole Westlund, MA
PhD student, School of Kinesiology
Western University

An Evaluation of an Imagery Training Program with Varsity Curlers

Informed Consent

I, _____ have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Signature: _____ Date: _____

Name of Researcher: _____ Date: _____

Signature: _____

Project Title: An Imagery Training Program with Novice Curlers

Investigators: Nicole Westlund, MA, & Craig Hall, PhD, Western University

Letter of Information

(Study 3)

1. Invitation to Participate

You are being invited to participate in a study titled “An Imagery Training Program with Novice Curlers.” Imagery is one of the most popular techniques in psychological skills training programs (Short et al., 2002). It involves the mental simulation of performing physical skills, which can cause changes in motor learning, cognition, affect, and behaviour (Martin et al., 1999). Little attention has been paid by researchers on the mental skills used by curlers.

2. Purpose of the Letter

The purpose of this letter is to provide you with information required for you to make an informed decision regarding participation in this research.

3. Purpose of this Study

The purpose of this study is to evaluate the effectiveness of a season-long imagery training program conducted with novice curlers.

4. Inclusion Criteria

Individuals who are regular curlers (i.e., curl at least twice per week during the curling season) and are novices (i.e., have not yet competed at a provincial or national level) are eligible to participate in this study.

5. Exclusion Criteria

Individuals who are not regular curlers (i.e., curl less than twice per week during the curling season) or are highly experienced (i.e., varsity athlete; have provincial/national experience) are not eligible to participate in this study.

6. Study Procedures

If you agree to take part in this study, you will be asked to participate in a season-long imagery training program. Your commitment to the study will be as follows:

| | |
|---------------------------------|---|
| <u>Week 1</u> | You will be asked to complete an initial questionnaire package including; the Movement Imagery Questionnaire-Revised (MIQ-R) which examines your ability to engage in mental imagery, and the Sport Imagery Questionnaire (SIQ), which assesses the types of imagery you engage in. You will also be asked to complete a computerized Curling Strategy Evaluation Tool, which will test your ability to choose the correct shot to call in a given situation, as well as the time it takes you to select the correct shot. This process will take approximately 20 minutes to complete. |
| <u>Baseline</u> | Each week, you will be asked to complete a shorter Curling Strategy Evaluation until the imagery training program begins. |
| <u>Imagery Training Program</u> | The imagery training program will consist of weekly sessions that will take place prior to your practice or game at the curling club, beginning at a time to be determined later. At each imagery session, you will be asked about your imagery practice during the previous week, complete a shortened version of the Curling Strategy Assessment Tool and go through an imagery script with the researcher. All of this will take 20 minutes. In addition, you will be given copies of the imagery script to take home and practice on your own as well as record your imagery practice in a journal. |
| <u>Week 18</u> | You will complete a questionnaire package including the SIQ, Curling Strategy Evaluation Tool, and a Follow-up questionnaire. |

7. Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

8. Possible Benefits

The possible benefits to participants may be an improvement in imagery ability due to increased imagery practice, which may subsequently improve their curling performance. The possible benefits to society may be a better understanding of how novice curlers use imagery and how its use can be improved over the course of a curling season. These findings may be applicable to other curlers and athletes in other sports.

9. Compensation

You will not be compensated for your participation in this research.

10. Voluntary Participation

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your future athlete status. You will also have the option of having all data removed from the study and be destroyed if you decide to withdraw from the study or miss a significant number of imagery sessions.

11. Confidentiality

All data collected will remain confidential and accessible only to the investigators of the study. You will be assigned a subject number to track your data across the intervention. If the results of the study are published, only the subject number, age and gender will be used. While we do our best to protect your information, there is no guarantee that we will be able to do so. Your data will be stored in a password-protected computer that can only be accessed by the investigators and will be destroyed after five years.

12. Contacts for Further Information

If you require any further information regarding this research project or your participation in the study you may contact Nicole Westlund. If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics.

13. Publication

If the results of the study are published, your name will not be used. If you would like to receive a copy of any potential study results, please contact Nicole Westlund.

Thank you!

Investigators:

Nicole Westlund
PhD Candidate, School of Kinesiology
Western University

Dr. Craig Hall
Professor, School of Kinesiology
Western University

This letter is yours to keep for future reference.

Project Title: An Imagery Training Program with Novice Curlers

Investigators: Nicole Westlund, MA, & Craig Hall, PhD, Western University

Consent Form

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Child's Name: (if applicable) _____

Participant's Name (please print): _____

Participant's Signature: _____

Date: _____

Parent / Legal Guardian / Legally Authorized
Representative (if applicable) Print: _____

Parent / Legal Guardian / Legally Authorized
Representative (if applicable) Sign: _____

Parent / Legal Guardian / Legally Authorized
Representative (if applicable) Date: _____

Person Obtaining Informed Consent (please print): _____

Signature: _____

Date: _____

Project Title: Examining the Use of Cognitive General Imagery in Curling

Primary Investigator: Dr. Craig Hall, Western University

Co-Investigators: Nicole Westlund, Despina Kouali, Western University

Letter of Information

(Study 4)

1. Invitation to Participate

You are being invited to participate in a study titled "Examining the Use of Cognitive General Imagery in Curling" because you are a curler and play the position of skip.

2. Purpose of the Letter

The purpose of this letter is to provide you with information required for you to make an informed decision regarding participation in this research.

3. Purpose of this Study

The purpose of this study is to examine the use of cognitive general (CG) imagery in curling. We will only be recruiting curlers who have experience playing the skip position as they are the ones directing the strategy during games. We will be conducting three focus groups with five participants each to determine how CG imagery is used in curling.

4. Inclusion Criteria

In order to be eligible to participate in the study, participants must be over the age of 18, be a regular curler (recreational and competitive) with at least five years of experience, and are currently playing the skip position.

5. Exclusion Criteria

Participants will be excluded from the study if they are under the age of 18, not a regular curler (i.e., currently playing in a recreational league or competitively), has less than five years of curling experience, or is not currently a skip on a curling team. Participants must also consent to being audio recorded during the interviews.

6. Study Procedures

If you agree to take part in this study, you will be asked to participate in a focus group with the researcher, each lasting approximately 45 minutes. We will be asking about your experience with cognitive general imagery in curling. The interview will take place at the curling club at a time that is convenient for you and will be audio recorded.

7. Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

8. Possible Benefits

Participants may benefit from hearing the experiences of other athletes participating in the focus group. They may hear of new strategies to incorporate into their own imagery use, which in turn could help improve their curling performance.

9. Compensation

You will not be compensated for your participation in this research.

10. Voluntary Participation

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your status on the team. You will also have the option of having all data removed from the study and be destroyed if you decide to withdraw from the study.

11. Confidentiality

All data collected will remain confidential and accessible only to the investigators of the study. If the results of the study are published, only your age and gender will be used but will be discussed in a group context. Direct quotes from the interview may be used when discussing the results and for this, participant numbers will be used in place of your real name to protect your identity. While we do our best to protect your information, full confidentiality is not guaranteed. Please refrain from discussing this study outside of the research setting. Once the audio recording of the interview has been transcribed and verified, the recording will be permanently deleted. Your data, including interview transcripts, will be stored in a password-protected computer that can only be accessed by the investigators and will be destroyed after five years.

12. Contacts for Further Information

If you require any further information regarding this research project or your participation in the study you may contact Dr. Craig Hall, Nicole Westlund, or Despina Kouali. If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics. Representatives of Western University's Non-Medical Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

13. Publication

If the results of the study are published, your name will not be used. If you would like to receive a copy of any potential study results, please contact Nicole Westlund or Despina Kouali.

Thank you!

Investigators:

Nicole Westlund
PhD Candidate
School of Kinesiology
Western University

Despina Kouali
PhD student
School of Kinesiology
Western University

Dr. Craig Hall
Professor
School of Kinesiology
Western University

This letter is yours to keep for future reference.

Project Title: **Project Title:** Examining the Use of Cognitive General Imagery in Curling
Primary Investigator: **Dr. Craig Hall, Western University**
Co-Investigators: Nicole Westlund, Despina Kouali, Western University

Consent Form

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Please check off the following boxes to indicate your consent:

- ☐ I consent to being audio recorded during the interview.
- ☐ I will allow the researcher to use direct quotes given by myself for purposes of presenting and publishing the results of this study. If one of my quotes is used, I understand that a pseudonym (fake name) will be used to identify my responses and my real name will not be used. Thus, I will not be identifiable in the results.

Participant's Name (please print): _____

Participant's Signature: _____

Date: _____

Person Obtaining Informed Consent (please print): _____

Signature: _____

Date: _____

APPENDIX O

Research Ethics Board Approval Notices

Study 1 (Phase 1)



Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Craig Hall
 File Number: 102538
 Review Level: Full Board
 Approved Local Adult Participants: 100
 Approved Local Minor Participants: 0
 Protocol Title: Validation of a Curling Strategy Evaluation - 19019S
 Department & Institution: Health Sciences/Kinesiology, Western University
 Sponsor:
 Ethics Approval Date: May 16, 2012 Expiry Date: May 31, 2013

Documents Reviewed & Approved & Documents Received for Information:

| Document Name | Comments | Version Date |
|-----------------------------|--|--------------|
| Western University Protocol | | |
| Other | Email and Script to Participants for Recruitment | |
| Letter of Information | | |

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussions related to, nor vote on, such studies when they are presented to the NMREB.

The Chair of the NMREB is Dr. Riley Hinson. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer to Contact for Further Information

| | |
|-------------------------------------|--|
| Grace Kelly (grace.kelly@uwo.ca) | Janice Sutherland (jsutherl@uwo.ca) |
|-------------------------------------|--|

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The University of Western Ontario

Office of Research Ethics

Support Services Building Room 5150 • London, Ontario • CANADA - N6G 1G9
 PH: 519-661-3036 • F: 519-850-2466 • ethics@uwo.ca • www.uwo.ca/research/ethics

Study 1 (Phase 2)



**Western
Research**

**Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice**

Principal Investigator: Dr. Craig Hall
Department & Institution: Health Sciences/Kinesiology, Western University

NMREB File Number: 105419
Study Title: Item Validation for the Curling Strategy Assessment Tool
Sponsor:

NMREB Initial Approval Date: July 17, 2014
NMREB Expiry Date: June 30, 2015

Documents Approved and/or Received for Information:

| Document Name | Comments | Version Date |
|---------------------------------|--|--------------|
| Letter of Information & Consent | Letter of Information and Informed Consent Form | 2014/05/09 |
| Instruments | Scenarios 31-60 to be validated | 2014/06/18 |
| Instruments | Scenarios 61-93 to be validated | 2014/06/18 |
| Instruments | Scenarios 1-30 to be validated | 2014/06/18 |
| Instruments | Updated demographic questionnaire including changes requested by NMREB | 2014/06/16 |
| Recruitment Items | Updated e-mail recruitment script with additions suggested by NMREB | 2014/06/16 |
| Western University Protocol | Updated Western study protocol with revisions | 2014/07/02 |

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

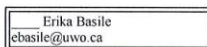
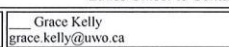
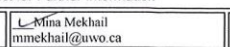
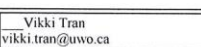
Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.



NMREB Chair

Ethics Officer to Contact for Further Information

| | | | |
|---|--|---|--|
|  Erika Basile ebasile@uwo.ca |  Grace Kelly grace.kelly@uwo.ca |  Mina Mekhail mmekhail@uwo.ca |  Vikki Tran vikki.tran@uwo.ca |
|---|--|---|--|

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London, ON, Canada N6G 1G9 t. 519.661.2161 f. 519.661.3907 www.westernu.ca/research

Study 2



Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Craig Hall
Review Number: 18425S
Review Level: Full Board
Approved Local Adult Participants: 24
Approved Local Minor Participants: 0
Protocol Title: An Evaluation of an Imagery Training Program with Varsity Curlers
Department & Institution: Kinesiology, University of Western Ontario
Sponsor:
Ethics Approval Date: November 03, 2011 **Expiry Date:** August 31, 2012

Documents Reviewed & Approved & Documents Received for Information:

| Document Name | Comments | Version Date |
|---------------------------------|--------------|--------------|
| UWO Protocol | | |
| Letter of Information & Consent | | |
| Advertisement | Email Script | |

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussions related to, nor vote on, such studies when they are presented to the NMREB.

The Chair of the NMREB is Dr. Riley Hinson. The UWO NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Signature _____

Ethics Officer to Contact for Further Information

| | |
|---|---|
| <input checked="" type="checkbox"/> Grace Kelly (grace.kelly@uwo.ca) | <input type="checkbox"/> Janice Sutherland (jsutherl@uwo.ca) |
|---|---|

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Office of Research Ethics

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Study 3



**Western
Research**

Research Ethics

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Craig Hall
File Number: 104147
Review Level: Full Board
Approved Local Adult Participants: 4
Approved Local Minor Participants: 0
Protocol Title: The effects of cognitive general imagery training on decision making abilities in curling: A single-subject multiple-baseline approach
Department & Institution: Health Sciences/Kinesiology, Western University
Sponsor:
Ethics Approval Date: September 23, 2013 Expiry Date: August 31, 2014

Documents Reviewed & Approved & Documents Received for Information:

| Document Name | Comments | Version Date |
|---|---|--------------|
| Instruments | An example of a script that participants will be administered by the researcher as part of their weekly imagery training program. Scripts will differ based on different scenarios. | 2013/07/29 |
| Instruments | This questionnaire will be used to gauge participants' reactions to participating in the intervention; provides valuable feedback that will aid in the data analysis and interpretation of results. | 2013/07/29 |
| Instruments | Questionnaire to be administered once the imagery training program begins. It will serve as a manipulation check to track participants' imagery practice outside of the weekly meetings with the researcher. | 2013/07/29 |
| Instruments | Questionnaire to collect data on imagery ability; to be collected during the first week of the intervention to ensure each participant has sufficient abilities to participate in the imagery training program. | 2013/07/29 |
| Instruments | Questionnaire collecting information on imagery use, to be administered during the first and last week of the intervention. | 2013/07/29 |
| Western University Protocol | | 2013/08/02 |
| Response to Board Recommendations | Revisions made in response to board recommendations. | 2013/09/14 |
| Revised Letter of Information & Consent | Headings have been added to letter of information; consent form for all participants (16 years and older). | 2013/09/14 |
| Recruitment Items | Updated e-mail script to be used for participant recruitment. | 2013/09/14 |
| Instruments | Updated Demographic Questionnaire as per NMREB recommendations. Question #2 (gender) has been changed to a "fill-in-the-answer" format to accommodate participants who may not self-identify with male or female. | 2013/09/14 |
| Other | Schedule for randomized imagery training program across participants | 2013/07/29 |




This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussions related to, nor vote on, such studies when they are presented to the NMREB.

The Chair of the NMREB is Dr. Riley Hinson. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer to Contact for Further Information

| | | |
|---|--|---|
|  Grace Kelly (gkelly@uwo.ca) |  Vikki Tran (vikki.tran@uwo.ca) |  Erika Basile (ebasile@uwo.ca) |
|---|--|---|

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Study 4



**Western
Research**

Research Ethics

**Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice**

Principal Investigator: Dr. Craig Hall

Department & Institution: Health Sciences/Kinesiology, Western University

NMREB File Number: 106202

Study Title: Examining the use of cognitive general imagery in curling

Sponsor:

NMREB Initial Approval Date: March 9, 2015

NMREB Expiry Date: March 09, 2016

Documents Approved and/or Received for Information:

| Document Name | Comments | Version Date |
|---|------------------------------|--------------|
| Recruitment Items | Email script for recruitment | 2014/12/17 |
| Recruitment Items | Recruitment poster | 2014/12/17 |
| Instruments | Interview guide | 2015/02/04 |
| Revised Western University Protocol | | 2015/02/25 |
| Revised Letter of Information & Consent | | 2015/02/25 |

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

[Redacted Signature] of Health & Human Services under the IRB registration number IRB

[Redacted Signature] Chair or delegated board member

ethics officer to contact for further information

| | | | |
|--------------------------------|-----------------------------------|---------------------------------|---------------------------------|
| Erica Basile ebasile@uwo.ca | Grace Kelly grace.kelly@uwo.ca | Mina Mekhail mmekhail@uwo.ca | Vicki Tran vicki.tran@uwo.ca |
|--------------------------------|-----------------------------------|---------------------------------|---------------------------------|

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Curriculum Vitae

CURRICULUM VITAE FOR NICOLE WESTLUND STEWART

School of Kinesiology
Western University
London, Ontario, Canada

POST-SECONDARY EDUCATION

| | | |
|--------------|--|--|
| 2012-Present | PhD Candidate in Psychological Basis of Kinesiology | Western University London, ON |
| 2010-2012 | Master of Arts in Kinesiology (Sport Psychology) | Western University London, ON |
| 2006-2010 | Bachelor of Science with Specialized Honours in Psychology | Lakehead University Thunder Bay, ON |

AWARDS & HONOURS

| Title | Granting Agency | Value, Duration | Tenure |
|---|---|-------------------------------|---------------|
| Doctoral Fellowship | Social Sciences and Humanities Research Council (SSHRC) | \$20,000 per year, 2 years | 2014-2016 |
| Academic All-Canadian | Canadian Interuniversity Sport (CIS) | 5 years | 2010-2015 |
| Ontario Graduate Scholarship Master's Award | Ontario Graduate Scholarship Program | \$15,000, 1 year | 2011-2012 |
| Canada Graduate Scholarship (CGS) – Master's Award | Social Sciences and Humanities Research Council (SSHRC) | \$17,500, 1 year | 2010-2011 |
| Canadian Psychological Association Certificate of Academic Excellence Laureate – Honours Thesis | Canadian Psychological Association (CPA) | n/a | 2010 |
| Lakehead University Entrance Scholarship of Academic Excellence | Lakehead University | \$2,500 per year, 4 years | 2006-2010 |

PUBLICATIONS

Journal Articles

- Westlund Stewart, N.,** & Hall, C. R. (in press). The effects of cognitive general imagery use on decision accuracy and speed in curling. *The Sport Psychologist*.
- Westlund Stewart, N.,** & Hall, C. R. (2016). The effects of cognitive general imagery training on decision making abilities in curling: A single-subject multiple baseline approach. *Journal of Applied Sport Psychology*, doi:10.1080/10413200.2016.1213331.
- Pope, J. P., **Westlund Stewart, N.,** Law, B., Hall, C. R., Gregg, M. L., & Robertson, R. (2015). Knowledge translation of sport psychology to coaches: Coaches' use of online resources. *International Journal of Sport Science & Coaching*, 10(6), 1055-1070.
- Westlund Stewart, N.,** Divine, A., O, J., & Law, B. (2015). Considerations for conducting imagery interventions in physical education settings. *Journal of Imagery Research in Sport and Physical Activity*, 10(1), 31-47. doi:10.1515/jirspa-2015-0001
- Westlund, N.,** Oinonen, K. A., Mazmanian, D., & Bird, J. L. (2015). The value of middle phalangeal hair as an anthropometric marker: A review of the literature. *HOMO - Journal of Comparative Human Biology* 66, 316-331. doi:10.1016/j.jchb.2015.02.003
- Westlund, N.,** Pope, J. P., & Tobin, D. (2012). Cognitive general imagery: The forgotten imagery function? *Journal of Imagery Research in Sport & Physical Activity*, 7(1), article 1. doi:10.1515/1932-0191.1075

Abstracts

- Westlund Stewart, N.,** & Mekers, W. F. (2016). Neural efficiency of elite curlers' brains during imagery training of strategy-based decision making. *Journal of Sport & Exercise Psychology*, 37, S269.
- Westlund Stewart, N.,** Kouali, D., & Hall, C. R. (2016). Why athletes use cognitive general imagery in curling: A qualitative investigation. *Journal of Sport & Exercise Psychology*, 37, S269-270.
- Kouali, D., **Westlund Stewart, N.,** & Hall, C. R. (2016). The content of cognitive general imagery use in curling. *Journal of Sport & Exercise Psychology*, 37, S217-218.
- Westlund, N.,** & Hall, C. (2015). Item validation of the Curling Strategy Assessment Tool (CSAT). *Journal of Sport and Exercise Psychology*, 37, S151.
- Law, B., Hall, C., Divine, A., **Westlund, N.,** Edmunds, A., & O, J. (2013). Imagine the possibilities: Children's use of imagery in physical education. *Journal of Sport & Exercise Psychology*, 35, S96-97.

Westlund, N., & Hall, C. (2013). The effects of a cognitive general imagery intervention on decision efficiency and accuracy in curling: A preliminary investigation. *Journal of Sport & Exercise Psychology*, 35, S119.

Publications in Progress

Westlund Stewart, N., Kouali, D., & Hall, C. R. (2016). Functions and situations associated with cognitive general imagery use. *Manuscript submitted for publication.*

REFEREED CONFERENCE PRESENTATIONS

Westlund Stewart, N., & Mekers, W. F. (2016). *Neural efficiency of elite curlers' brains during imagery training of strategy-based decision making.* Poster presented at the 2016 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, Montreal QC.

Westlund Stewart, N., Kouali, D., & Hall, C. R. (2016). *Why athletes use cognitive general imagery in curling: A qualitative investigation.* Verbal presentation at the 2016 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, Montreal QC.

Kouali, D., Westlund Stewart, N., & Hall, C. R. (2016). *The content of cognitive general imagery use in curling.* Verbal presentation at the 2016 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, Montreal QC.

Westlund, N., & Hall, C. (2015). *The effects of a season-long imagery intervention on curling performance: A mixed methods evaluation.* Poster presentation at the 2015 annual meeting of the Canadian Society for the Psychology of Sport and Physical Activity, Edmonton, AB.

Westlund, N., & Hall, C. (2015). *Item validation of the Curling Strategy Assessment Tool (CSAT).* Poster presentation at the 2015 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, Portland, OR.

Westlund, N., & Hall, C. (2014). *The effects of cognitive general imagery training on decision making abilities in curling: A single-subject multiple baseline approach.* Verbal presentation at the 2014 annual meeting of the Canadian Society for the Psychology of Sport and Physical Activity, London, ON.

Law, B., Hall, C., Divine, A., Westlund, N., O, J., & Edmunds, A. (2013). *Imagine that! Implementing a mental imagery intervention in elementary school physical education classes.* Council of University Professors and Researchers (CUPR) research forum at PHE Canada conference, Winnipeg, MB.

Ste-Marie, D. M., Law, B., Carter, M. J., Westlund, N., Divine, A., & Martini, R. (2013). *Group vs. individual administration of the MIQ for Children yields different movement imagery scores.* Poster presented at the 2013 annual meeting of the Canadian Society for the Psychology of Sport and Physical Activity, Kelowna, BC.

- Westlund, N., & Hall, C.** (2013). *The effects of a cognitive general imagery intervention on decision efficiency and accuracy in curling: A preliminary investigation.* Verbal presentation at the 2013 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, New Orleans, LA.
- Law, B., Hall, C., Divine, A., **Westlund, N.**, Edmunds, A., & O, J. (2013). *Imagine the possibilities: Children's use of imagery in physical education.* Poster presented at the 2013 annual meeting of the North American Society for the Psychology of Sport and Physical Activity, New Orleans, LA.
- Westlund, N., & Hall, C.** (2012). *The validation of a curling strategy evaluation for use in future imagery interventions.* Poster presented at the 2012 annual meeting of the Canadian Society for Psychomotor Learning and Sport Psychology, Halifax, NS.
- Westlund, N., & Hall, C.** (2011). *Examining the relationships between imagery, sport motivation, and athletic identity in curling.* Verbal presentation at the 2011 annual meeting of the Canadian Society for Psychomotor Learning and Sport Psychology, Winnipeg, MB.
- Oinonen, K., Richards, M., Mazmanian, D., Marshall, B., & **Westlund, N.** (2010). *Earlier menarche is associated with lower positive impression management and higher social detachment.* Co-author on poster at the 2010 annual meeting of the Canadian Psychological Association, Winnipeg, MB.

RESEARCH EXPERIENCE

- | | |
|-----------|---|
| 2015-2016 | <i>Graduate Research Assistant:</i> Mobile robots for telepresence and ADL (activities of daily living) assistant, Western University, funded by AGE-WELL. |
| 2014-2016 | <i>Graduate Research Assistant.</i> Exercise at Western, Western University, funded by a CIHR Grant. |
| 2012-2013 | <i>Graduate Research Assistant:</i> Exploring the development of children's perceptions of competence and enjoyment in physical education, Western University, funded by a SSHRC Standard Research Grant. |
| 2009-2010 | <i>Undergraduate Research Assistant:</i> Health, Hormones, and Behaviour (HHAB) Lab, Lakehead University. |

TEACHING EXPERIENCE

- | | |
|-----------|---|
| 2016 | <i>Western Certificate in University Teaching.</i> Teaching Support Centre, Western University, London, ON. |
| 2014 | <i>Graduate Teaching Assistant, KIN 3474:</i> Psychological Interventions for Sport, Exercise and Injury Rehabilitation. School of Kinesiology, Western University. |
| 2010-2012 | <i>Graduate Teaching Assistant, KIN 2276:</i> Psychology of Exercise. School of Kinesiology, Western University. |

INVITED LECTURES AND PRESENTATIONS

- 2016 *The Effects of Cognitive General Imagery Use on Strategy Performance in Curling*. Seminar for Psychological Basis of Kinesiology Graduate Student Seminar, Western University.
- 2016 *The Effects of Cognitive General Imagery Use on Strategy Performance in Curling*. Guest Lecture for KIN 3474: Psychological Interventions for Sport, Exercise, and Injury Rehabilitation, Western University.
- 2015 *The Use of Humour in Sport*. Presentation for the 2015 RowOntario Conference held in Toronto, ON.
- 2015 *Stress, Stress Reactivity, and Exercise*. Lecture for KIN 2276: Psychology of Exercise. School of Kinesiology, Western University.
- 2015 *Physical Activity Interventions*. Lecture for KIN 2276: Psychology of Exercise. School of Kinesiology, Western University.
- 2015 *Imagery in Sport*. Lecture for KIN 3474: Psychological Interventions for Sport, Exercise and Injury Rehabilitation. School of Kinesiology, Western University.
- 2014 *Applied Consulting*. Lecture for KIN 9230: Psychological Interventions in Sport, Exercise and Injury Rehabilitation. School of Kinesiology, Western University.
- 2014 *APA Formatting*. Lecture for KIN 3474: Psychological Interventions for Sport, Exercise and Injury Rehabilitation. School of Kinesiology, Western University.
- 2013 *Mental Toughness in Sport*. Lecture for KIN 3474: Psychological Interventions in Exercise Rehabilitation. School of Kinesiology, Western University.
- 2013 *Goal Setting in Sport*. Lecture for KIN 3474: Psychological Interventions in Exercise Rehabilitation. School of Kinesiology, Western University.
- 2012 *Mental Training: Focus, Imagery and Goal Setting*. Presentation for Ontario Summer Games Throws Training Camp held at Western University.
- 2012 *Stimulus Response Theory & Behavioral Economic Theory*. Guest lecture for KIN 2276: Psychology of Exercise. School of Kinesiology, Western University.
- 2012 *Mental Toughness in Sport*. Lecture for KIN 3474: Psychological Interventions in Exercise Rehabilitation. School of Kinesiology, Western University.
- 2011 *APA Formatting*. Lecture for KIN 2276: Psychology of Exercise. School of Kinesiology, Western University.
- 2011 *Mental Toughness in Sport*. Lecture for KIN 3474: Psychological Interventions in Exercise Rehabilitation. School of Kinesiology, Western University.
- 2010 *APA Formatting*. Lecture for KIN 2276: Psychology of Exercise. School of Kinesiology, Western University.

SCHOLARLY ACTIVITIES

Research Service

- 2016 Reviewer for *Journal of Applied Sport Psychology* and co-reviewer for *Frontiers in Psychology: Movement Science and Sport Psychology*.
- 2014 Reviewer for the *International Journal of Sport and Exercise Psychology* and *Journal of Imagery Research in Sport and Physical Activity*.
- 2013 Reviewer for the *Journal of Sports Sciences*.
- 2011 Co-reviewer for *The Sport Psychologist*.
- 2010 Co-reviewer for *Perceptual and Motor Skills*.

Other Scholarly Services

- 2015-2016 Organized *Writing Circle*, an initiative for Kinesiology graduate students. The goal of this program was to provide an opportunity for peer-feedback on writing through weekly/bi-weekly meetings.
- 2014-2016 Chair of the Kinesiology Graduate Student Association, formerly known as the Kinesiology Graduate Board. My role was to support the incoming president(s) in the transition from the 2013-14 to 2014-15 and 2014-15 to 2015-16 school years.
- 2015 External Student Reviewer for Graduate Program Review, Western University.
- 2014-2015 Graduate Student Representative on the Selection Committee for the Dean of the Faculty of Health Sciences, Western University.
- 2014-2015 Student Representative on the Executive Committee for the North American Society for the Psychology of Sport and Physical Activity.
- 2014 Assistant to the conference chairs for the 2014 Canadian Society for the Psychology of Sport and Physical Activity conference, held in London, ON.
- 2013-2014 President of Kinesiology Graduate Board, headed the KGB executive council and sat on various committees to represent Kinesiology Graduate student interests to the Faculty and Administration. Organized events to promote collaboration within the program, as well as promoting our graduate program to new students.
- 2012-2013 Vice President (VP) Academic for the Kinesiology Graduate Board, represented the academic interests of Kinesiology Graduate Students at Western University.
- 2011-2012 Member of the planning committee (Treasurer) for the Eastern Canadian Sport and Exercise Psychology Symposium, held at Western University, London, ON.
- 2010-2011 Assistant to the conference chair for the 2011 North American Society for the Psychology of Sport and Physical Activity conference, held in Burlington, VT.